

Proposing a Rating System for the Accessibility of Video Games

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Abstract

Video games have existed for over 50 years and in that time much has changed about them. Computers have become more powerful, screen resolution has gotten higher, and game design has been changed and iterated upon. Video games are one of the most profitable industries in the world, and yet many modern-day video games still lack some of the basic functionality that lets people play them easily. People with disabilities often struggle to comfortably play video games because of poor accessibility options. Many games lack subtitles or the ability to remap controls or even the ability to change the difficulty.

In this paper, after researching various methods for rating disabilities and video games, I propose a system that assesses the accessibility of video games. By rating a game and displaying that rating to potential customers, it will allow disabled gamers to make more informed purchasing decisions, and not accidentally buy a game that they cannot play.

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1 Introduction

Digital culture is a significant part of modern society. At the time of writing, a large part of the world's population is stuck indoors due to COVID-19, and we can see first-hand how important computers are. For some people, computers are the only way in which they can talk to their families and friends. Many people have to work from home, and so they rely on their computers to store their information and contact their employers. People also rely on computers for their entertainment, whether that be watching a film online or playing a video game. While computers and other digital devices work well for most people, others struggle to get the same amount of enjoyment and utility from them.

Disabled people often struggle to use digital systems that do not accommodate their needs. In a 2017 survey, it was revealed that over 12% of Americans have some form of disability (2017 Disability Statistics Annual Report, 2017). If a group this large is struggling to use modern technology, steps should be taken to ensure it is easier and more inclusive for them.

Great strides have been taken in recent years to make the internet more accessible. Laws have been put in place across the world that ensure websites are accessible to everyone. The Web Content Accessibility Guidelines (WCAG) in particular are a great help to the disabled, and legal precedents have been set in some countries that ensure people follow those guidelines.

When it comes to accessibility in video games though, there seems to be a lack of progress. While there are several organisations devoted to helping disabled gamers, such as The AbleGamers and SpecialEffect, which showcase different ways in which in which games can be made more accessible, there are still very few resources that enable people to rate a game's accessibility, and there is no way to tell how accessible a game is by looking at the box or it's download page on a digital distribution platform, which can lead to customer dissatisfaction if they have to return a game they are unable to play. In this paper, I plan to offer a solution to this problem by proposing a rating system for video game accessibility.

In order to develop this system, and make it as useful and broadly accessible as possible, I will be taking the following approach. I will examine examples of digital accessibility, real world accessibility, and accessibility features that are present within games. I will be researching how organisations in related fields have gone about creating their own rating systems. The The Pan European Game Information (PEGI) system for deciding a video game's age rating is of particular interest as it is in the same field, and the system that the Paralympics Committee uses to place disabled athletes in the same leagues as each other will also be of interest, as it is a way of directly measuring disability. I will be doing this because these rating systems work well, and aspects of them will likely also work well for an accessibility rating system for video games. This is important because disabilities can come in hundreds of different varieties, so researching an existing system for categorising them will be of great value.

I plan to review several of the best-selling games in recent times in order to get a sense for the quality of accessibility features in modern video games. Based on this research, I will then devise a system that can properly rate the accessibility of video games. I will also propose a system that showcases how accessible these games are to people who will potentially buy them. This will prevent disabled gamers from accidentally buying a game that does not accommodate them. Not only that, but this system will make it so that developers can easily check what features can be implemented to make their games more accessible.

There has been a significant amount of research into disabilities in general, and how to make everyday activities more accessible for the people who have disabilities. A considerable amount of work has been done to bring attention to disabled gamers as well. Organisations such as SpecialEffect and The AbleGamers do a significant amount of work to help disabled gamers enjoy their hobby in ways that suit them. Outside of video games, the Paralympic Committee have done a lot of work bringing awareness to various disabilities, while also promoting and showcasing the amazing feats disabled athletes are capable of performing.

The Game Accessibility Guidelines (GAG) are a set of guidelines developed by a group of studios, academics and specialists that show developers ways in which they can make their

games more accessible. This existing research will be an invaluable resource as it will greatly aid in the creation of a system that assesses the accessibility of a game.

There is very little work that aims to give a precise estimate for how accessible a game is. There is also no way to tell how accessible a game will be from looking at its box, unless the creators have added that information, which they are not required to do. A lack of a standard set of guidelines for what accessibility features to add also makes the jobs of game developers more difficult.

In this paper, I aim to thoroughly examine the existing research on accessibility in video games and use it as a grounds to propose a rating system for video game accessibility. In turn, I hope that this will serve as an important step towards allowing disabled gamers to make informed purchasing decisions without having to do extensive prior research. In the next section of this paper I will examine the existing bodies of research that relate to this topic.

2 Literature Review

2.1 Disabilities

In their paper, Beeston et al. (2018) conducted a survey of over 150 people with disabilities and found that the majority needed assistive technology in order to play video games. Assistive technology includes resources such as custom controllers and difficulty adjustments within the game. They estimated at the time that between 2.2 and 2.6 billion people worldwide play video games, and this number grows every year. In a separate study, Porter and Kientz (2013) found that their sample of 154 people tended towards playing single player games and less towards multiplayer games. This is interesting to note, as there is already a high barrier to entry for many competitive multiplayer games, due to the fact that more advanced players will make the game harder for beginners.

One limitation of this survey is that it excluded people who have cognitive disabilities due to consent issues. However, the study does include people with mental health difficulties, and that group makes up a large proportion of the respondents. In Beeston et al.'s study, the majority of respondents said that they played video games for 2-4 hours at a time. Interestingly, this is significantly more than the average for gamers as a whole. In a report done by Limelight Network (The State of Online Gaming, 2018), a large number of gamers are shown to play games for an average of 1 hour and 20 minutes at a time.

The majority of respondents to Beeston et al.'s survey identified themselves as gamers, and considered gaming to be their primary hobby. This makes it all the more important that developers make sure to add accessibility options to make it so that people with disabilities can fully enjoy their games.

The majority of respondents played games on PC, with mobile phones being the second most common device. This would indicate that the PC has the best accessibility options. It is likely that this is partially due to the fact that more games are available on PC, due to a lack of screening for what games can be uploaded. This means that anyone can find a game that suits

them and has the accessibility options they require. I also believe this is partially because of the modular nature of PCs. There is a much lower barrier for entry for people to modify their PC, or add custom controllers that make it easier to use than on consoles. Another reason PC may be the most common platform is that accessibility is more mature on that platform. Video game modding is quite popular on PC. Modding is a practice where people make their own changes to a game, without being associated with the developers. Since anyone can modify a game on PC, accessibility options can be added to a game after the fact, so developers need not have added any accessibility options for a game to still be playable after some modification.

It is interesting that mobile phones ranked so highly on this list. It is possible that this is because of the prevalence of mobile phones in modern years and because of the nature of touch screens. Developers for mobile games had to adapt to the unique characteristics of phones when designing control schemes, and so tilt controls and tapping the touch screen is the primary way for gamers to communicate with the device, both of which are generally quite accessible options.

Popular assistive technology options were subtitles, key remapping options, contrast options, colour changes, text enlargement and auditory or screen alerts.

Most players preferred playing single player games, followed by online multiplayer, followed by co-operative multiplayer and then competitive multiplayer. The results of their survey show that players with disabilities' tastes in games align with those of the masses, suggesting that gaming preference is not universal and not dictated by ability.

In their article, Bierre et al. (2005) specifically mention how the lack of accessibility ratings on the box of video games is a problem. If consumers are not able to tell whether or not a game is playable by them, it leads to games being returned to shops, or people being unsatisfied by their purchases.

There are many ways in which developers can make their games more accessible. Adding training modes, speed control, variation in difficulty and options to change the controls are all ways to improve the experience for people who suffer from physical disabilities. Too much

speech or text can also be a turnoff for people with learning or cognitive disabilities, so options to remove or reduce the amount of speech or text in a game would also go a long way.

Websites have to be accessible due to the United States' Workforce Investment act of 1998, and video games are a logical extension of that since they are used in a similar manner.

There are several issues that could come up for people while playing video games depending on their disability. If they have problem hearing, they may be unable to follow a game storyline without the aid of cutscenes, clues given for puzzles could be purely sound based, or they may be killed too often if the game relies on audio cues. Similarly, if they have a disability involving vision, they may miss visual clues for puzzles; maps and other information used to orient the player could become useless. If a gamer has a cognitive disability, they may not be able to understand an overly complex storyline, a puzzle may not have a difficulty option or a setting may be too overwhelming and contain flashing lights. Gamers with physical disabilities may not have the dexterity to play certain games without the aid of a custom mouse or controller, and they may not have the physical ability to respond quickly.

Based on US census data from 2017, over 12% of the US had a form of disability (2017 Disability Statistics Annual Report, 2017), ranging from visual to auditory to physical to mental. Potential assistive technology solutions are alternative pointing devices, such as a modified joystick or eye tracking technology. On-screen keyboards can also be useful. Speech recognition can help people with limited mobility, and screen readers are essential for people with vision impairments. Screen magnifiers can also be useful for the visually impaired. Hardware such as voice recognition systems and different types of mice and external controllers are also useful.

At the time of writing, Bierre et al. only listed 3 games from the last few years that they thought had good accessibility options, and also mentioned racing games as a genre, had good accessibility. The three specific games they mentioned for their accessibility were *Half-Life 2* (2004), *Doom 3* (2004) and *Terraformers* (2003). They praised *Half-Life 2* for its closed captioning system. After the release of *Half-Life* (1998), several deaf gamers got in contact with Valve, and requested a closed captioning system, which they then fully implemented for the sequel. The developers also hired several deaf gamers to help them test the game. One concern

developers have before implementing accessibility features is that it will increase development time. However Valve found in this case that the delay was minimal, and the results justified it.

Doom 3 did not provide closed captions for the players. However, it did have a set of tools that others could use to modify the game. Gamers took this tool and used it to create a closed caption mod for *Doom 3*. While it was not officially part of the game, ID Software provided significant support to the project by giving access to scripts and sound files in the game. While it is concerning to think that this was an example of good accessibility at the time, it is comforting to know that accessibility options have come a long way in the last ten years.

Terraformers was a game designed, from the beginning, for the visually impaired. The game can be played with normal graphics, or these graphics can be turned off and replaced by a sonar system where objects in front of the player are identified, and the distance to them is told to the player. The player is also told if the object is dangerous. *Terraformers* won the innovation in audio award at the Independent Games Festival 2003.

The driving game *F355 Challenge* (2001) also has good accessibility options although Bierre et al. doubt whether this was intentionally for disabled gamers. The gameplay involves racing around an oval track, and due to its simplicity, it is relatively easy for gamers to control the car. There is also an ‘intelligent’ braking system, which makes the car brake slightly when turning a corner, making it easier for players with slower reaction times to drive the car. In addition to driving assistance, it also provides players with a tutorial mode showing a red line that indicates the optimal path to follow while racing. Players are also alerted to corners by flashing symbols and spoken prompts. Many features, including the controls, can be changed by the user.

In his paper, *Promoting Game Accessibility: Experiencing an Induction on Inclusive Design Practice* at the Global Games Jam, Michael James Scott discusses his findings when it comes to accessibility after taking part in the global game jam event. Global Games Jam is an annual event where developers from all over the world make a game based on the same unknown theme in 48 hours. Scott was made more aware of accessibility features after attempting to make a game with a modifier ‘accessibility’. He mentions how an issue for many developers is that return on

investment is crucial for game development, so the addition of accessibility features must be worthwhile. If developers do not stand to gain from their addition, then they are not motivated to do so.

Scott mentions how, with enough foresight, accessibility can be implemented within a short time frame with very few resources. He demonstrated this by successfully creating a game with accessibility options in 48 hours for the game jam.

Scott discusses how there are 6 areas that need to be addressed by game developers in order to have good accessibility.

- 1) Becoming aware of key issues in games.
- 2) Developing design and problem solving skills.
- 3) Appreciating pertinent issues within the industry.
- 4) Being aware of, and active in, discussion surrounding accessibility in the industry.
- 5) Experimenting with and spreading new ideas, while also watching out for new ideas.
- 6) Networking with other developers in order to discuss accessibility.

He further notes that his and others' ability to make a fully functioning and accessible game in 48 hours is a strong indicator that accessibility options should be a standard in all mainstream games.

In their book Ellis and Kent (2011) discuss how social media and the internet have allowed everyone, including disabled people to be more connected, but there are still barriers to overcome when it comes to disability. As a response, Ellis and Kent propose 'universal design', which is a design philosophy in which the developer seeks to include the widest possible user base. Ellis and Kent mention how the Centre for Universal Design (1997) identified seven features for universal design.

- 1) The design must be equitable. This means it must be useful to a wide range of people of varying disabilities or lack thereof.
- 2) It must be flexible enough to be used in different ways by different people.
- 3) The design should be easy to understand, regardless of the users' previous experience.

- 4) Information should be communicated effectively to the user regardless of their sensory ability.
- 5) There should be room for errors in a way that minimises the impact of possible mistakes and makes sure there are no consequences for these mistakes.
- 6) There should be little to no physical exertion required
- 7) The user should be able to access the technology regardless of their size, posture or mobility.

The Central Statistics Office (CSO) of Ireland classifies the 7 main types of disabilities as blindness or serious vision impairment, deafness or a serious hearing impairment, an intellectual disability, difficulty in learning, remembering or concentrating, a condition that limits basic physical activities, chronic illness, and a psychological or emotional condition. The CSO define some of these disabilities as follows.

- Spinal cord injuries can sometimes lead to lifelong disabilities that limit physical activity. They mostly occur in severe accidents but can also be a result of a birth defect. They can be complete or incomplete. In an incomplete injury the messages conveyed by the spinal cord are not completely lost, whereas a complete injury results in a total dis-functioning of the sensory organs.
- Common vision based impairment include scratched cornea, scratches of the sclera, diabetes related eye conditions, dry eyes and corneal grafts.
- Hearing related impairments includes complete or partial deafness. People with partial deafness can use hearing aids to assist them.
- Cognitive/learning disabilities are a kind of impairment present in people who suffer from dyslexia and various other learning difficulties. This includes speech disorders.
- Psychological disorders are based around mood or feeling. Mental health impairment is the term used to describe psychiatric problems or illnesses such as personality disorders (defined as deeply inadequate patterns of behaviour and thought of such severity as to cause significant impairment to day-to-day activities; or schizophrenia, a disorder characterised by disturbances of thinking, mood and behaviour).

- Chronic illnesses are described as illnesses that cause difficulty connected with pain, breathing or other chronic illnesses

The CSO offers a detailed description of the 7 main categories of disability. However, they offer no advice on how the lives of people with these disabilities could be improved or made easier. When it comes to disabilities in relation to video games, it seems that many of the mental based disabilities would offer similar accessibility problems, whereas vision, hearing and motor based disabilities would all have very unique problems associated with them. The chronic illness category is slightly too vague to be put into practice. If it had to be included, it seems that it would have an effect on a person's ability to play games in a similar way to that of someone who has a motor function based disability. Both groups of disabled people could have issues concentrating due to pain.

The Game Accessibility Guidelines (GAG) are a set of guidelines that outlines dozens of features that can be added to video games that make them more accessible. They have a similar six categories that they group accessibility options into. These categories are; general, speech, hearing, vision, cognitive and motor. Each category is split into three sub-categories, which are basic, intermediate and advanced accessibility guidelines. The basic sub category lists options that are easy to implement and have wide reaching effects, the intermediate sub-category lists options that require a bit of foresight to implement, and the advanced sub-category lists options that are for complex solutions or for niche disabilities. Each sub-category has several suggestions as to how games can be made more accessible. For instance, in the cognitive category a basic option would be to have an easily readable default font size, an intermediate option would be to have contextual in-game guidance, and an advanced option would be to provide pre-recorded voice overs for all text.

While the GAG are very thorough, many of their options are too niche to be applied to anything other than a very specific game.

2.2 Video Game Rating Systems

There are several different rating systems for video games depending on geographic region. The Entertainment Software Rating Board (ESRB) is a self-regulatory organisation that assigns age

and content ratings, enforces industry adopted advertising guidelines and ensures responsible online privacy principles for video games. This organisation came into existence after a controversy surrounding the game Mortal Kombat.

The Pan European Game Information (PEGI) is the primary system used in Europe (Pegi Age Ratings | PEGI Public Site, 2020). It was created by the Interactive Software Federation of Europe and replaced many age rating systems in Europe with a single system. It is now used in more than 31 countries. Every publisher using the PEGI system is contractually obliged to follow its code of conduct.

The PEGI system has 5 age ratings that are dependent on whether they contain certain content. Age rating is not an indication of the difficulty of the game or the skill required to play it. The five age ratings are 3, 7, 12, 16, and 18+. These age ratings are designated based on whether a game contains violence, bad language, fear, gambling, sex, drugs, discrimination, or in game purchases. Prior to 2015, if a game contained online features, it would also affect its rating. This factor was discontinued due to the frequency with which modern games require online features. Each of these factors have their own icons that will appear on the box.

- Violence



Figure 1 - PEGI Violence icon

- Bad Language



Figure 2 - PEGI Bad language Icon

- Fear/Horror



Figure 3 - PEGI Fear/Horror Icon

- Gambling



Figure 4 - PEGI Gambling Icon

- Sex



Figure 5 - PEGI Sex Icon

- Drugs



Figure 6 - PEGI Drugs Icon

- Discrimination



Figure 7 - PEGI Discrimination Icon

- Online



Figure 8 - PEGI Online Icon

- In-Game Purchases



Figure 9 - PEGI In-Game Purchases Icon

The PEGI system is well designed and their consistency, clarity and general approach can serve as inspiration for a disability-focused rating system. Their placement of the symbols denoting why a game has received their age rating is of particular interest and will be an inspiration for the proposed accessibility rating system. Depending on what my research shows me, I will have to

choose whether the symbols denote a lack of accessibility options or the fact that they have accessibility options. This will be based on how frequently the games I test have accessibility options. If accessibility is common, these symbols will denote a lack of options since that's unusual, if accessibility is uncommon, the symbols will denote that there are accessibility options as a mark of quality, and also because it would be uncommon.

When the online guideline was removed from PEGI's list, it was shown that PEGI are not opposed to changing their guidelines as games progress. My proposed rating system could potentially be added as an extension of PEGI's existing rating system. By adding this new system to PEGI's existing system, it would instantly give it more authority, as it would be supported by an organisation that already has a lot of contacts with the game industry and is well respected.

2.3 Disability rating

In the Paralympics, a rating system is employed in order to categorise different disabilities with a view to make sure competition is fair and not one-sided. The International Paralympics Committee (IPC) website goes into detail about how this classification is done (International Paralympic Committee. 2020).

Different sports require athletes to perform different tasks, and a particular impairment could impact one sport very differently to another. For instance, an athlete with restricted mobility in their legs would have a very different experience in a sprint than in a rowing race. Because of this, the IPC disability classification is sport-specific. When classifying the level of disability an athlete has, the athlete is assessed by a trained panel of three people. The assessors are told to consider three questions;

- 1) Does the athlete have an eligible impairment for this sport?
- 2) Does the athlete's eligible impairment meet the minimum criteria of the sport?
- 3) Which sport class describes the athlete's activity limitation most accurately?

The first step of the process is to make sure the athlete has an eligible impairment. There are 10 eligible impairment types.

- 1) Impaired muscle power: Reduced force generated by muscle groups, such as muscles of one limb or the lower half of the body, as caused for example, by spinal cord injuries, spina bifida or polio.
- 2) Impaired passive range of movement: range of movement in one of more joints is reduced permanently, for example due to arthrogryposis. Hypermobility of joints, joint instability, and acute conditions, such as arthritis, are not considered eligible impairments.
- 3) Limb deficiency: Total or partial absence of bones or joints as a consequence of trauma (e.g. car accident), illness (e.g. bone cancer) or congenital limb deficiency (e.g. dysmelia).
- 4) Leg length difference: Bone shortening in one leg due to congenital deficiency or trauma.
- 5) Short stature: Reduced standing height due to abnormal dimensions of bones of upper and lower limbs or trunk, for example due to achondroplasia or growth hormone dysfunction.
- 6) Hypertonia: Abnormal increase in muscle tension and a reduced ability of a muscle to stretch, due to a neurological condition, such as cerebral palsy, brain injury, or multiple sclerosis.
- 7) Ataxia: Lack of coordination of muscle movements due to a neurological condition, such as cerebral palsy, brain injury or multiple sclerosis.
- 8) Athetosis: Generally characterised by unbalanced, involuntary movements and a difficulty in maintaining a symmetrical posture, due to a neurological condition such as cerebral palsy, brain injury, or multiple sclerosis.
- 9) Vision impairment: Vision is affected by an impairment of eye structure, optical nerves or optical pathways, or the visual cortex.
- 10) Intellectual impairment: A limitation in intellectual functioning and adaptive behaviour as expressed in conceptual, social and practical adaptive skills, which originates before the age of 18.

Each paralympic sport has its own group of permitted impairments.

The second step is to make sure the disability meets the minimum disability criteria. Each sport has its own rules describing how severe an impairment must be for an athlete to be considered eligible. This is assessed based on scientific research, which evaluates how much of an impact an impairment would have on an athlete's ability to play the sport. The IPC makes sure to state that an athlete not being eligible does not question the presence of their impairment, and their intention is not to pass judgement. Their only goal is to make sure that the competition is as fair and balanced as possible.

The third step is to put the athlete into the correct sport class. This is a way of grouping contestants of a similar ability together to make sure the competition is fair. For instance, two people could have the same type of impairment in that they have limited arm movement, but one athlete could be able to move more than the other. By separating these two into different sport classes, the IPC assessors make sure the competition is fair and balanced. Athletes in the same sport class do not necessarily need to have the same impairment. So long as their impairments are deemed to limit them in a similar manner when it comes to their sport, they are allowed to compete together. This is why in wheelchair racing events, you can see athletes with paraplegia and leg amputations in the same race.

Due to the progressive nature of some impairments, an athlete's classification is not set in stone. An athlete could be assessed several times in their life, and therefore end up competing in different sport classes.

3 Methodology

Evidence from my literature review has shown what areas of accessibility need to be focused on. The six areas of accessibility I will be focusing on are the ones addressed by the GAG, those being, general accessibility, speech, hearing, vision, cognitive, and motor accessibility. General accessibility focuses on miscellaneous things that can help anyone, such as difficulty settings and save states. Speech accessibility deals with how easy it is for players to communicate. Hearing accessibility focuses a lot on subtitles, but also covers volume controls for all aspects of sound, and ensuring that hard-of-hearing players can still get all the information they need. Vision accessibility revolves around making things on screen as clear as possible, removing aspects of the game that could cause motion sickness, and adding options that allow visually impaired players to receive all the information they need to play. Cognitive accessibility largely focuses on making games playable by people with disorders such as epilepsy or dyslexia, but also making games easy to understand through the use of tutorials and hints. Finally, motor accessibility allows players to remap controls to their liking, and have options to make the game playable by people with reduced reaction time.

The GAG lists dozens of ways in which games can be made more accessible for each of these groups. However, many of them are only applicable in certain scenarios, and many are examples of good game design in general. I have elected to trim down the list into a much smaller one. All the accessibility guidelines on this list are easily measurable, and can only be present or absent. All the accessibility guidelines on this list are designed for console gaming as well, so options that are specific to PC gaming have been removed. I have also combined some similar options into more general options. This makes understanding the system easier, and will also make rating games using the system easier.

Some of the accessibility options are duplicated over different sections. For example, subtitles are an example of hearing and vision accessibility, and the option to turn off haptic feedback is an example of cognitive accessibility and motor accessibility. Instead of removing the duplicate options, I have decided to keep them for their relevant sections. This is because even though they are the same thing, they serve slightly different functions depending on a person's disability, and are a necessary element in giving an accurate judgement on a game's accessibility.

Some of the accessibility options will not be applicable for all games. For instance, the option to disable blood and gore is obviously not applicable to games where blood and gore are not present. Similarly, in 2D games, there is no need for a field of view slider, as it cannot exist. I have decided to keep these options in, however, as the games and genres that these categories apply to are quite common, and even though a large portion of games will not have use for them, a consumer is still likely to come across a game that does have need of them, and it would be counterintuitive to remove them just because not all games are affected by them.

3.1 Accessibility Assessment Categories

In order for a game to be deemed accessible using my proposed system, they must be judged against the previously stated six accessibility categories. In the sections below, I will define the individual requirements a game must meet.

3.1.1 General

- **Difficulty settings:** By adding a difficulty system to a game, a developer takes steps to ensure that players of a much larger range of skills can play their game. This is good for every consumer, not just disabled gamers.
- **Manual saving:** Allowing players to manually save the game gives them the freedom to stop and take a break whenever they need. It also gives them the option to return to previous sections and try them again at will.
- **Automatic saving:** Automatically saving the game puts players at ease, since they no longer have to worry about losing progress if they die, or accidentally turn off the game.

3.1.2 Speech

This section covers accessibility options based around being able to speak and use your voice. The options on this list are primarily there to make sure anyone playing a game can communicate.

- **Speech should not be necessary to play:** This requirement is to ensure that players who have trouble speaking can play the game with ease.
- **Visual means of communicating in multiplayer:** By giving players the option to use a text chat to communicate, or even a sophisticated ping system (the ability to place a marker in-game that is visible to your teammates), as seen in Apex Legends or Fortnite, it allows players who are incapable of speaking to play teamwork based games. This requirement is not necessary for games with no multiplayer component.

3.1.3 Hearing

This section covers options that allow people who are hard of hearing to experience the game properly. These options are primarily about giving people ways other than hearing to receive information.

- **Provide subtitles:** The addition of subtitles enables gamers who are hard of hearing to get information that they might have missed.
- **Subtitles for all sounds:** This would include having subtitles for sound effects such as gunfire or explosions, or background dialogue. This ensures that players do not miss any information that might not be the focus of the camera.
- **Separate volume controls for different audio sources:** This would require developers to add a separate volume mixer for music, dialogue and effects so that the players can balance them in whatever way they wish.
- **No essential information is covered only by sound:** This requirement would ensure that developers potentially add a visual indicator for important information as well as sound. For instance, in a shooter, if a player is getting shot from behind, add an indicator on the screen showing the player the direction of the sound of gunfire.
- **Visual means of communicating in multiplayer:** This option makes sure that gamers who are hard of hearing can receive information from people they are playing with.

3.1.4 Vision

The options in this section allow people who have vision impairments to receive information they might have missed.

- **High contrast between subtitles and background:** This feature would require that subtitles are legible against any background. The most common way of achieving this would be to have white text with a black border around the letters, or for white text to have a semi-transparent black box around it.
- **Allow field of view to be adjusted in 3D games:** By widening the field of view, it allows gamers with vision impairments to see things that may have been obscured from them otherwise.
- **Avoid, or allow the option to remove, head bob:** Some games, generally first person shooter (FPS) games, have an animation that implies the character is moving. For instance, if a character is running, the camera will move up and down in time with their steps to convey movement. Some gamers find this nauseating, and so it is best to either remove it, or have the option to lessen it.
- **Screen reader support:** This option allows gamers with vision impairments to get necessary information they may not have gotten without it.
- **Colourblind mode:** This requirement would ensure that developers add an option to change the colour of their game in order to ensure colourblind people can see all the relevant information.
- **Allow interface to be adjusted:** This option would allow gamers to change the size or position of the heads up display (HUD) to their preference.
- **Allow font size adjustment:** Even if a game has subtitles, the subtitles may be too small for some gamers, rendering them useless. This option ensures that the subtitles can be useful to everyone.

3.1.5 Cognitive

These options are designed for people with learning disabilities. They are made to offer help to disabled gamers in ways that are not patronising.

- **Include tutorials:** This option makes sure that all gamers can practice and fully understand the game.
- **Allow players to progress through text at their own pace:** By allowing the player to dictate the speed at which text appears and disappears, it makes sure that the player doesn't miss anything.
- **Avoid flickering images and repetitive patterns:** This option is to make sure no one, especially people with epilepsy, get overwhelmed by the visuals of a game.
- **Include hints during gameplay:** This can range from telling the player where to go, what their next objective is and how to interact with different aspects of the game. This ensures that players always know how to play the game.
- **Include the option to adjust game speed:** by changing the speed of a game, it lets players with a wide skill gap to play the same game. Some players may not have the reaction time to play a particularly fast game, and this option will help them.
- **Include toggle/slider for haptic feedback:** haptic feedback is when a controller vibrates after the player does something. Some gamers can find this overwhelming or stressful, so the option to remove it or reduce it is helpful.
- **Option to disable blood and gore:** In particularly violent games, blood and gore is prevalent, which some gamers can find distressing. The option to remove viscera will make the game more playable for them.

3.1.6 Motor

The options in section are made for people who lack the full range of motion, or for people who feel pain from playing ways in conventional ways.

- **Allow controls to be remapped:** The default control scheme in some games may not be accessible to everyone. The option to change the controls to whatever the player wants ensures that anyone can play the game.
- **Allow look sensitivity adjustment:** Some gamers are not capable of making fine motor adjustments, such as what might be required in a first person game to turn the player camera. This option will allow those players to adjust how fast or slow the point of view moves.

- **Toggle for haptic feedback:** Some gamers find the vibration from controllers to be painful, or the controller vibrating could cause them to lose grip. By allowing them to turn off this feature it makes sure the game is playable.
- **Option to adjust game speed:** Some gamers do not have the fine motor skills to play fast paced games. By allowing the player to change the speed of the game it could open up the game to them.
- **Allow interfaces to be adjusted:** Some gamers find navigating menus to be difficult, by allowing players to change their menus, some of this struggle can be eased.
- **Provide a macro system:** Macros are a system in which multiple inputs can be programmed into one button. For instance in fighting games, in order to do a certain move a player must hit several buttons in rapid succession. By giving the player the option to have macros, it allows players of all abilities the option to input a quick series of button presses.
- **Support more than one input device:** By giving the player the option to play with a gamepad, or a mouse and keyboard or any other sort of controller it gives players the option to play using the input device they are most comfortable with.

I needed to find a list of games that it was likely for consumers to encounter. To do this I found a list of the best-selling games of 2019 (Grubb, 2020) and selected the ten highest ranking games. Because these games have sold the best, it is likely that your average gamer would have come across them, and a gamer with disabilities would have a need for a system that ranks their accessibility. Grubb lists the top ten best-selling games of 2019 as:

- 1) *Call of Duty: Modern Warfare* (2019)
- 2) *NBA 2K20* (2019)
- 3) *Madden NFL 20* (2019)
- 4) *Borderlands 3* (2019)
- 5) *Mortal Kombat 11* (2019)
- 6) *Star Wars Jedi: Fallen Order* (2019)
- 7) *Super Smash Bros. Ultimate* (2018)

- 8) *Kingdom Hearts III* (2019)
- 9) *Tom Clancy's The Division 2* (2019)
- 10) *Mario Kart 8* (2017)

To evaluate the proposed rating system, I will analyse each of these games and assess their accessibility using my proposed system.

4 Results/Findings

To find out whether each game on the list achieved the suggested accessibility guidelines, I individually tested each one. The first step was to locate the options button. This was usually one of the first buttons you come across so finding it was usually not an issue. For some games like *Super Smash Bros. Ultimate* (SSBU) however, the options button was placed in an unusual position. It never took very long to find the options, but some games made it easier than others.



Figure 10 - *Super Smash Bros. Ultimate* Options Menu

Once the options button was located, I navigated through the different sections looking for options to enable or disable certain accessibility features. This was relatively simple for most features, as difficulty settings, subtitles, volume controls, field of view (FOV) settings, colourblind mode, and haptic feedback options were all laid out quite well. One aspect of the process that slowed me down was that there was no standardisation for where accessibility options were placed. For instance the option to enable subtitles could be anywhere from the menus labeled Graphics, to Audio or even Gameplay. In SSBU subtitles are present in the game, but there is no option to disable them. This does not affect its accessibility rating, but it does

demonstrate that a lack of standardisation can lead to confusion for the player.



Figure 11 - Super Smash Bros. Ultimate Sound Menu



Figure 12 - Super Smash Bros. Ultimate Difficulty Menu

Once I was satisfied that I had found all the available accessibility options in the menus, I played through each game in order to find the remaining accessibility features, or lack thereof. Features you can only find through playing include requirements such as avoiding flickering images, including hints during gameplay and no essential information is only covered by sound. These are options that you would rarely want to turn off, regardless of your ability, so there would be no reason for there to be that option in the menus.

This process was repeated across all 10 games on the list.

Audio based accessibility options seem to be the easiest to implement due to the fact that most of the rated games achieved the majority of these options. It seems that more general accessibility options such as difficulty settings were also easy to implement. Cognitive and motor accessibility options were incorporated less frequently; this could be due to these features requiring more foresight to implement, such as avoiding flashing lights, or having support for screen readers.

To evaluate the proposed rating system, I took the best-selling games of 2019 and checked them against the rating system in order to get a sample for what settings are common or uncommon, see what accessibility features need to be developed and highlighted, and to validate the rating system by application.

More work could be done in the future to improve the system by potentially having a user study with disabled people and experts in order to validate my findings, but this was beyond the scope of this paper.

All of the games on the list had a selection of different difficulty options for players to choose from. This was to be expected, as video games have commonly had difficulty settings for decades, as it is an option that appeals to everyone, not just people with disabilities. Every game on the list was playable without the use of speech as well. However, I expect this has less to do with accessibility options and more to do with the lack of games in general that can only be played using speech.

The 10 games on the list had a wide variety of genres. There were 3 shooters, 2 sports games, 2 fighting games, 1 racing game, 3 3rd person games (by default), 2 1st person games (by default), 2 single player games and 8 multiplayer games (all of which had single player content). My results were as follows:

	Call of duty modern warfare 2019	NBA 2K20	Madden NFL 20	Borderlands 3	Mortal Kombat 11	Star Wars: Jedi Fallen Order	Super Smash Bros Ultimate	Kingdom Hearts III	Tom Clancys the Division 2	Mario Kart 8 Deluxe
General										
Difficulty settings	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Manual saves	No	Yes	Yes	No	No	Yes	No	Yes	No	No
Automatic saves	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	2/3	3/3	3/3	2/3	2/3	3/3	2/3	3/3	2/3	2/3

Figure 13 - General Accessibility

	Call of duty modern warfare 2019	NBA 2K20	Madden NFL 20	Borderlands 3	Mortal Kombat 11	Star Wars: Jedi Fallen Order	Super Smash Bros Ultimate	Kingdom Hearts III	Tom Clancys the Division 2	Mario Kart 8 Deluxe
Speech										
Speech is not necessary to play	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Visual means of communicating in multiplayer	Yes	No	Yes	Yes	Yes	NA	No	NA	Yes	No
	2/2	1/2	2/2	2/2	2/2	1/1	1/2	1/1	2/2	1/2

Figure 14 - Speech Accessibility

	Call of duty modern warfare 2019	NBA 2K20	Madden NFL 20	Borderlands 3	Mortal Kombat 11	Star Wars: Jedi Fallen Order	Super Smash Bros Ultimate	Kingdom Hearts III	Tom Clancys the Division 2	Mario Kart 8 Deluxe
Hearing										
Provide subtitles	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Subtitles exist for all sounds	No	No	No	Yes	No	No	No	No	Yes	No
Separate volume controls for different audio sources	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
No essential information is only covered by sound	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Visual means of communicating in multiplayer	Yes	No	Yes	Yes	Yes	NA	No	NA	Yes	No
	4/5	3/5	4/5	5/5	4/5	2/4	3/5	2/4	5/5	0/5

Figure 15 - Hearing Accessibility

	Call of duty modern warfare 2019	NBA 2K20	Madden NFL 20	Borderlands 3	Mortal Kombat 11	Star Wars: Jedi Fallen Order	Super Smash Bros Ultimate	Kingdom Hearts III	Tom Clancys the Division 2	Mario Kart 8 Deluxe
Vision										
High contrast between subtitles and background	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
Allow field of view to be adjusted in 3D games	Yes	NA	NA	Yes	NA	No	NA	No	Yes	No
Avoid or allow the option to remove headbob	No	NA	NA	Yes	NA	NA	NA	NA	No	NA
Screen reader support	No	No	No	No	No	No	No	No	Yes	No
Colourblind mode	Yes	No	Yes	No	No	No	No	No	Yes	No
Allow interface to be adjusted	No	No	No	Yes	Yes	No	No	Yes	Yes	No
Allow font size adjustment	No	No	No	Yes	No	No	No	No	Yes	NA
	3/7	1/5	2/5	5/7	2/5	1/6	1/5	2/6	6/7	0/4

Figure 16 - Vision Accessibility

	Call of duty modern warfare 2019	NBA 2K20	Madden NFL 20	Borderlands 3	Mortal Kombat 11	Star Wars: Jedi Fallen Order	Super Smash Bros Ultimate	Kingdom Hearts III	Tom Clancys the Division 2	Mario Kart 8 Deluxe
Cognitive										
Includes tutorials	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Allow players to progress through text at their own pace	No	No	No	No	Yes	No	Yes	No	No	NA
Avoid flickering images and repetitive patterns	No	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes
Include hints during gameplay	No	No	Yes	Yes	No	Yes	No	Yes	Yes	No
Include option to adjust game speed	No	Yes	No	No	No	No	No	No	No	No
Include toggle/slider for haptic feedback	No	No	No	No	No	Yes	Yes	Yes	Yes	No
Option to disable blood and gore	Yes	NA	NA	Yes	No	NA	NA	NA	No	NA
	2/7	2/6	3/6	2/7	2/7	4/6	4/6	4/6	3/7	1/5

Figure 17 - Cognitive Accessibility

	Call of duty modern warfare 2019	NBA 2K20	Madden NFL 20	Borderlands 3	Mortal Kombat 11	Star Wars: Jedi Fallen Order	Super Smash Bros Ultimate	Kingdom Hearts III	Tom Clancys the Division 2	Mario Kart 8 Deluxe
Motor										
Allow controls to be remapped	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No
Allow look sensitivity adjustment	Yes	Yes	No	Yes	NA	No	Yes	Yes	Yes	No
Toggle for haptic feedback	No	No	No	No	No	Yes	Yes	Yes	Yes	No
Option to adjust game speed	No	Yes	No	No	No	No	No	No	No	No
Allow interfaces to be adjusted	No	No	No	Yes	Yes	No	No	Yes	Yes	No
Provide a macro system	No	No	No	No	Yes	No	No	No	No	No
Support more than one input device	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
	3/7	4/7	1/7	4/7	4/6	3/7	3/7	5/7	4/7	1/7

Figure 18 - Motor Accessibility

	Call of duty modern warfare 2019	NBA 2K20	Madden NFL 20	Borderlands 3	Mortal Kombat 11	Star Wars: Jedi Fallen Order	Super Smash Bros Ultimate	Kingdom Hearts III	Tom Clancys the Division 2	Mario Kart 8 Deluxe
Total	16/31	14/28	15/28	20/31	14/28	14/27	14/28	17/27	22/31	5/26
	51.60%	50%	53.60%	64.50%	50%	51.90%	50%	63%	71%	19.20%

Figure 19 - Total Accessibility

Most of the general, speech, and hearing guidelines were achieved by most of the games tested, implying that these options are useful to everyone, and so the developers have more of an incentive to add. It could also suggest that these features are easier to implement. When it comes to speech, this certainly would appear to be the case, because there are very few games that require the ability to speak. Hearing is more important when it comes to video games, but a player could still manage to play many games without it. When it comes to the general options, these are features that have existed in games for decades, so it makes sense that most of the games achieved these.

The vision, cognitive and motor guidelines were achieved less frequently. A large number of the vision guidelines were deemed non-applicable. This was due to the fact that the selection of games tested had varying different visual styles and themes.

4.1 Speech

Every game on the list was playable without the use of speech, however I expect this has less to do with accessibility options and more to do with the lack of games in general that can only be played using speech. Most of the games that had multiplayer content had a way for players to communicate visually, such as a text chat system. Due to this, most of the games on this list have good speech accessibility options.

4.2 Hearing

All of the games but one had the option to have subtitles; however, only two of the games had the option to enable subtitles for all background sounds, such as gunfire or explosions. 80% of the games had a visual indicator for essential information as well, so that no essential information was only covered by sound. 80% of the games had separate volume mixers for different aspects of the game sound such as music, dialogue and effects. As discussed previously most of the games had the ability to communicate visually as well, which is also an accessibility option for the hard of hearing. Most of the games had good accessibility options for the hard of hearing, Mario Kart 8 Deluxe however didn't have any of the listed accessibility options for the hard of hearing.

4.3 Vision

All the games on this list bar one had subtitles, and all the games that had subtitles had a good contrast between the text and the background only two games allowed players to change the font size of the subtitles though. 4 of the games allowed players to adjust the interface to make it easier for them to see.

Half of the eligible 3D games had the option for players to change their FOV, but only half of them had the option for players to remove head bobbing animations. Surprisingly only one of the games had screen reader support, and only 30% of the games had a colourblind mode.

Overall, most of the games underperformed when it came to accessibility options for visibility. Tom Clancy's The Division 2 had the best results, only missing the option to remove head bob animations. Mario Kart 8 Deluxe once again did the worst, not managing to get a single one of the features.

4.4 Cognitive

The games were much more varied when it came to cognitive accessibility. All of the games are missing at least two accessibility features. 70% of the games had a tutorial mode for the players and half of the games had tool tips that appear in game that tell you what to do or how to do them.

Only 2 of the games allowed players to progress through text at their own pace. 60% of the games didn't contain much flashing imagery, and only 40% of the games allowed players to disable haptic feedback. Only one of the games allowed players to slow the speed of the game.

4.5 Motor

70% of the games allowed players to remap their controls. 60% of the games allowed players to change their look sensitivity, and 90% of the games allowed players to have multiple input devices. Unfortunately, only 40% of the games allowed players to disable haptic feedback, only 40% allowed players to adjust the game interface, and only 10% of the games allowed players to adjust the game speed and to have a macro system.

5 Analysis

In this section I will explore the meanings and implications of my results, and offer a solution to any problems to arise from them.

The games on this list only managed to deliver an average of 52.48% of the features recommended by the rating system. This suggests that video games have poor accessibility features, only managing to have just over half of the suggested features. The results of my test show that it is likely gamers will not have the accessibility features they need when they sit down to play a game if they have purchased it without doing any prior research. It also shows that developers have little reason to add anything but the bare minimum of accessibility features to their games. This is based on the fact that the games that sold the most during 2019 had relatively few accessibility features, proving that a lack of those features does not hinder their sales in a significant way.

So, if most games have poor accessibility features, and the developers and publishers of these games are not inclined to add them in, how can this problem be addressed? Firstly, talking to the developers and publishers of these games should not be discounted. Previous papers discussed in the literature review portion of this paper have shown that adding accessibility features need not be difficult, and accessibility features can be added relatively easily and inexpensively given enough foresight. By discussing these problems with the creators of video games, a lot of progress could be made. However, it would be down to the goodwill of the developers and publishers. I propose that a rating system be devised that indicates the accessibility of games, and that that rating should be prominently displayed on the cover of each game. This will encourage developers and publishers in several ways. Firstly, a publisher will want their game to be as marketable as possible, and if their game has a bad rating directly on the front of the box, that will make their game look the worse for it, which will inevitably impact sales negatively. On the opposite side of that, a good rating on the front cover of a game will make them look better, and also act as a mark of quality, similar to what Nintendo did in the 80's by adding the Nintendo seal of Quality to the front cover of officially licensed games.

How would this rating system function? I suggest that this system should work in a similar way to that of PEGI and the IPC rating system. I suggest that an independent council be tasked with rating the accessibility of video games. This council would rate the games based on the six categories outlined by the Game Accessibility Guidelines which are general, speech, hearing, vision, cognitive and motor accessibility. I suggest that this council use the same list of requirements used in this paper to assess the accessibility of the best-selling games from 2019. This list covers a wide array of different accessibility options that can be used to help disabled gamers.

I propose that the system work as follows: each game is checked against all 31 requirements covered in the list to find out how accessible they are. Based on their accessibility, they will be ranked as bronze, silver or gold. The total number of fulfilled requirements is then checked against the total number of requirements to find out what percentage of them a game has. This percentage will then be used to evaluate the overall ranking of the games' accessibility. The process will be repeated for each section of the list as well, so each game will receive a separate ranking for cognitive, motor, vision, etc. accessibility.

Some of the requirements in the list are not applicable to all games. For instance, the option to remove view bobbing would only be applicable to games that have view bobbing. When marking a game that has a non-applicable requirement, that requirement will not be included when calculating the accessibility score of the game. So if a game has 2 non-applicable requirements, it will be marked out of 29 instead of 31.

Finally, the percentage required to reach each ranking must be decided. Since most of the games that were tested only just managed to get 50%, I suggest that that is the baseline for what is an acceptable amount of accessibility features. Anything below 50% will be ranked as bronze, and anything 50% or above will be ranked silver. The highest ranked game had a 71%, but there were some features that could have been easily added, such as an option to remove blood and gore or a button to disable headbob. It would not have taken much more effort for this game to have attained a higher score. Therefore, I propose that 80% or higher should be considered a gold rank.

In conclusion, games with a percentage between 0 and 49 will be ranked bronze, games with a percentage between 50 and 79 will be marked silver and games with a percentage between 80 and 100 will be marked gold. This same percentage-based system will be applied to the individual sections of a game as well, so a game could have an overall accessibility ranking of silver, but a cognitive accessibility ranking of bronze. This will allow gamers to more accurately judge if the game they wish to buy is suitable for them.

In order to prove the validity of this proposed rating system, I will be rating the best and worst scoring games on the list of tested games.

5.1 Rating

Mario kart 8 had the worst score by a wide margin. I will explain how each individual category was rated and then explain its overall rating.

5.1.1 Mario Kart 8

General: Mario kart 8 (MK8) is missing a function to manually save, but it has difficulty settings and autosaves. Since it fulfils 2 out of the 3 requirements it gets 60% on general, giving it a ranking of silver for general.

Speech: MK8 does not require the player to speak in order to play the game, however it has no option that allows players to communicate visually in multiplayer. MK8 gets a 1 out of 2 for speech accessibility giving it 50% and just barely getting a silver ranking.

Hearing: MK8 performed abysmally when it came to hearing options, and didn't manage to hit a single requirement. It has no subtitles, no volume mixer, there are many examples of information that is only covered by sound and, once again, there is no visual way of communicating in multiplayer. MK8 gets a 0/5 firmly giving it a bronze ranking for hearing.

Vision: Some aspects of the vision requirements do not apply to MK8, so they have been removed. Since there are no subtitles, there is no reason to check if they have good contrast, similarly there is no reason to check if you can adjust their size. MK8 also has no head bob animations so there cannot be an option to remove it. Even after removing those options MK8 still falls short, and achieves none of the other requirements. There is no option to change the field of view, no screen reader support, no colourblind mode and the player cannot change the interface. After removing the 3 non-applicable requirements from the seven standard requirements, MK8 gets a 0/4 for vision accessibility.

Cognitive: two requirements here are not applicable for MK8. MK8 is a racing game with very little text, and therefore there is never a need for the player to progress through it at their own pace. Similarly, there is no blood and gore. Of the remaining 5 requirements, MK8 achieved one of them, in that it avoids flickering images and repetitive patterns. However it has no tutorial mode, no hints during gameplay, no option to adjust the game speed and no toggle to disable haptic feedback.

Motor: Finally, MK8 only achieved one of these seven requirements in that it can support more than one input device. Mk8 can be controlled with a stand gamepad or motion controls. It does not allow controls to be remapped, it does not allow look sensitivity to be changed, it has no toggle for haptic feedback, you cannot change the game speed, interfaces cannot be adjusted and there is no macro system in place.

The rating system normally has 31 requirements to be achieved, however 5 of them are not applicable to Mario Kart 8, therefore, MK8 has a score of 5 out of 26 or 19.2% of accessibility options. This score places Mario Kart 8 firmly in Bronze

5.1.2 Tom Clancy's The Division 2

Next, I will rate Tom Clancy's The Division 2 (TCTD2) for comparison, as it had the highest number of requirements achieved.

General: TCTD2 had 2 of the 3 requirements here, losing a point by not allowing manual saves.

Speech: TCTD2 got full marks for speech accessibility.

Hearing: TCTD2 once again achieved full marks in this section.

Vision: TCTD2 only missed the option to remove head bob animations in this section, giving it a 6/7 which is another gold ranking.

Cognitive: Fewer requirements were satisfied in this section. TCTD2 only gave players the option to have a tutorial mode, give hints during gameplay and an option to disable haptic feedback. The resulting score is a 3/7, which is a bronze rating.

Motor: 3 of the 7 requirements were missed in this section. There is no option to remap controls, no way to adjust the game speed and no macro system in place.

Overall Tom Clancy's The Division 2 satisfied 22 of 31 requirements, which equates to 71%. If the developers had just added some simple features such as controller remapping, the option to remove blood, removing head bob animations and the ability to move through text at their own pace, TCTD2 could have earned over 80%, which would have given it a gold rating.

5.1.3 Overall Rating

Call of Duty Modern Warfare 2019 achieved 51.6%, giving it a silver rating. NBA 2K20 received 50%, barely giving it a silver rating as well. Madden NFL 20 got 53.6%, also giving it a silver rating. Borderlands 3 had 64.5%, which is higher than the previous games, but still a silver rating. Mortal Kombat 11 achieved 50%, which is another silver. Star Wars Jedi: Fallen Order managed to get 51.9%, giving it a silver rating. Super Smash Bros. Ultimate received a 50%, which is a silver rating again. Finally Kingdom Hearts III has a good score coming out at 63%, which is a high silver.

As demonstrated, all but one game on the list has a rating of silver which I believe is reasonable. As discussed in the literature review portion of the paper, there are clearly some accessibility measures already in place in games, subtitles and difficulty settings for instance are very common, however there are still many features that can be added that will make the lives of disabled gamers easier.

5.2 Presentation

Now that the rating system itself has been established, the visual presentation of it should be decided upon. The overall accessibility rating should be prominently displayed on the front of the box for the reasons discussed earlier in this chapter. I also propose that a breakdown of the accessibility of the individual sections should also be displayed on the back of the box. That way, even if a game has poor accessibility overall, it may still have the right accessibility for the person buying it, which they will then be able to see.

I suggest that the overall accessibility should be displayed as an icon of the percentage the game received, in a housing next to the age rating. I suggest that the font used is an easy to read, white, sans serif font with a black border. I also suggest that the colour of the housing be the same colour as the rating they received, ie, gold, silver or bronze. This should allow customers to see at a glance whether the game has good accessibility or not. I also think it would be appropriate for the housing to be a different shape depending on its rating, for example, the housing of bronze rated games will be a circle, a triangle for silver rated games and a square for gold rated games. This way, customers who have trouble seeing colour will also be able to see the rating at a glance.

On the back of the box I suggest that each accessibility section should have it's own icon. I suggest that they all be contained within boxes of a similar shape to the PEGI rating system, but have the background colour be the same as the rating for that section's accessibility.

Each section's icon should be simple to understand, and for that reason I suggest they appear as follows:

- General: A set of gears (similar to the stereotypical settings button)
- Speech: An open mouth
- Hearing: An ear
- Vision: An open eye
- Cognitive: A brain
- Motor: A curled bicep

Each of these icons is visually distinct from one another, and would clearly show what they are meant to represent. Underneath the individual ratings at the back of the box I propose that there be a section outlining which accessibility features the game does *not* have. This will be another incentive for developers to add more accessibility options to their game, so that they have more room for other things on the back of their box.

If this system is adopted by game developers and publishers, then not only will it allow disabled gamers to purchase games off the shelf at a shop without having to do prior research on whether they can actually play it or not, but it will also incentivise developers to make games that are more accessible across the board, which would be a benefit to everyone who plays them, not just disabled gamers.

6 Conclusion

While writing this paper, my goals were to find out how accessible video games were to people with disabilities. After doing that, if I found the accessibility features available in video games to be lacking, I planned to propose a rating system that would be used to gauge a video game's accessibility. Finally, I planned on making suggestions as to how this system could be implemented in a way that would encourage video game developers and publishers to make their games more accessible to people with disabilities.

Through my research I found several surveys detailing the lives and preferences of disabled gamers. I found out that a large portion of the population has a disability and that many disabled people self-identify themselves as a gamer, and have it as one of their preferred hobbies. If a large portion of the population has an interest in gaming, then it is reasonable for them to be allowed to take part in that activity with the same degree of accessibility that most people have.

There are many examples of assistive technology that are available for disabled gamers. This technology includes things like custom controllers, such as the Xbox adaptive controller (*Xbox Adaptive Controller / Xbox*, 2020), eye tracking software and screen readers. All of these things can help disabled gamers experience games in a way that lets them enjoy them fully. I found that, naturally, disabled gamers enjoy a wide variety of different genres and as such, every genre of game should be equally accessible.

There are many ways in which people with disabilities can be impacted by a lack of accessibility options in video games.

People with speech impediments can have trouble communicating in multiplayer games, people who are hard of hearing need subtitles and other visual cues in order to get the information they need to play, and they rely on things like a text chat if they want to communicate with people in a team based game.

Gamers with sight issues need the text on screen to be as clear as possible, and many of them require options to reduce motion sickness from playing the game. Some visually impaired gamers would also need games to have screen reader support for them to play properly.

Gamers with cognitive disabilities such as autism, dyslexia or alzheimers might need several accessibility options that make the game easier for them. These can range from the inclusion of tutorials to changing how long text stays on screen for, to the option to change the speed at which the game runs.

Gamers who have trouble with motor skills will often need an option that allows them to change the controls of the game or may need the option to have a different type of controller. Some motor impaired gamers may need an option to disable the vibration from controllers as it could cause them pain, or cause them to lose their grip.

Finally, there are some general accessibility guidelines that affect all gamers, not just gamers with disabilities. The option to have different save states, or to change the difficulty of the game, are the most common general accessibility guidelines.

Much work can still be done on this topic. The accessibility guidelines I have outlined are not permanent. It is likely that new accessibility options will be designed and invented in the coming years, and the advancement of technology such as virtual reality and augmented reality brings with them an entirely new set of challenges and accessibility guidelines to be discovered. The system I have demonstrated can be built and iterated upon.

While my own system was thorough, it was based upon the best-selling games of 2019. It is possible that different results would come from looking at a random sample of games from the same year. It could be the case that the genre and type of games selected had an impact on the results as well. Further study and investigation could lead to more detailed results.

The proposed system could also be scrutinised by experts in accessibility or people with disabilities in order to test its usefulness and efficacy. This was beyond the scope of this paper, but would advance the topic.

There are no downsides to having more accessibility options. The introduction of the paralympics gave disabled athletes an event to show their expertise and prowess in the sport of their choosing. By adding more accessibility options to games it will give disabled gamers the freedom to play games in the same way that everyone else does.

The video game industry has advanced substantially in the past few decades. It is now one of the largest industries in the world, and in 2019 it made over 120 billion dollars (Takahashi, D., 2020). With enough investment into accessibility features, this hobby can become one that is shared by everyone, regardless of their ability.

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