Mitigation of Videogame Piracy

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Minimering av spel piratkopiering.

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Sammandrag:

Piratkopiering syftar på olaglig delning av upphovsrättskyddat digitalt material, såsom musik, filmer, programvara och böcker. Underhållningsbranschen, särskilt datorspelindustrin, har implementerat elektroniska rättighetskontroller för att bekämpa piratkopiering. Metoder som används för att förhindra piratkopiering, genom den finska föreningen Upphovsrättens informations- och övervakningscentral, fokuserar på individer som laddar ner innehåll, inte på de som sprider upphovsrättskyddat material. För detta lärdomsprov har en webbplats skapats med målet att förstå de olika lagren som potentiellt kan användas för att mildra piratkopiering i framtiden. Genom att få tillgång till en webbplatsdatabas, genom säkerhetsintrång, skulle personlig information om användare extraheras, men det kan vara för begränsat för att identifiera en individ.

Nyckelord:

Piratkopiering, Datorspel, Webbutveckling

Degree Thesis

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Abstract:

Piracy refers to the illegal distribution of copyrighted digital content, such as music, movies, software, or books. The entertainment industry, especially the video game industry, has been implementing tactics in the form of digital rights management to combat piracy. Methods in place for preventing piracy, by the Finnish organisation Copyright Information and Anti-Piracy Centre, focus on the individual downloading content, not on the offenders spreading copyright-protected media. For this thesis, a website was created with the aim of comprehending the various layers that could potentially be utilized to mitigate piracy in the future. With access to a website's database, through compromising the site's security, personal information about the users could be extracted, however, it may be too limited to identify an individual.

Keywords:

Piracy, Video games, Web development

1 Introduction

Piracy refers to the illegal distribution of copyrighted digital content, such as music, movies, software, or books. This typically involves making copies of the content and distributing it to others through file sharing, torrenting or other means, often for free. Piracy is illegal in most countries and is a violation of intellectual property rights. Video game piracy is more complex than traditional static media due to the interactive nature of games and the robust digital rights management systems used to protect products.

Piracy in the video game industry has had a complex impact. It leads to lost revenue and poses challenges for developers; it also raises questions about market accessibility and the effectiveness of anti-piracy measures. To fully address piracy a collaborative effort involving developers, publishers, players, and policymakers is required, however, it is unclear if the status quo needs to be changed or if piracy should be regarded as a fact of life in the industry. Some publishers use state-of-the-art protection methods, while others release games with no copy protection, either way, is shown to generate enough sales to turn a profit.

Creating pirated copies of video games can happen in separate ways, depending on the protection methods used. The most common way is to replace the file responsible for integrating the game into the platform the games are released on, such as Steam, this file is responsible for checking if the logged-in account has a valid license to the product. This method works when the game is released without anti-tamper solutions. In cases where anti-tamper methods are applied by the publisher, a skilled hacker needs to reverse engineer each game by hand to create a modified executable. Games can be released without copy protection and can be distributed without any modification.

To stop individuals from infringing copyright, the Copyright Information and Anti-Piracy Centre (CIAPC) monitors peer-to-peer networks and sends letters notifying the IP address owner that their network has been used for illegal activity.

There are websites dedicated to illegally sharing copyrighted content, targeting these might be a worthwhile effort to minimize the availability of pirated media. The thesis will aim to identify the weaknesses in an illegal file-sharing website, by creating a prototype website. A type of weakness could be the way user profiles are presented if enough personal information is shared law enforcement can more easily track offenders across the internet. Another area to consider is how the owner of the website can be identified.

The rest of the thesis is structured as follows: The second chapter will focus on what the piracy situation is like today, including a brief look at Finnish laws, the BitTorrent protocol often used to share files, how publishers try to protect against piracy, how piracy is countered by anti-piracy organizations and law enforcement, and how pirates are able to bypass the protection methods in place. The following chapter details the creation of a prototype website that mimics existing illegal sharing sites. The fourth chapter describes potential ways information can be gathered from the website, as well as covers potential points of failure when running an illegal website.

1.1 Aim and research question

The aim of this thesis is to identify weaknesses in illegal file-sharing websites by creating a prototype website. Based on this goal the following research question has been presented:

- What to consider when identifying weaknesses in illegal file-sharing websites?

2 The current state of video game piracy

There is no straightforward way to tell what effect piracy has on the video game industry. Some publishers, for example, CD Projekt RED, thrive without any form of protection from piracy while others, like Ubisoft, estimate huge profit losses can directly be linked to online piracy due to lost sales (Purchese, 2011). The concept of lost sales assumes that consumers would always purchase the product if the illegal source were not available. The consensus however in message boards and chat rooms online seems to be, that the pirate that purchases a legal copy for personal use is seen as an anomaly. When the pirate

pays for digital media, the intent is usually to share it with the community. According to Super Meat Boy developer Tommy Refenes (2013) piracy is not harmful to the industry.

> The reality is the fight against piracy equates to spending time and money combating a loss that cannot be quantified. Everyone needs to accept that piracy cannot be stopped, and loss prevention is not a concept that can be applied to the digital world. Developers should focus on their paying customers and stop wasting time and money on non-paying customers. Respect your customers and they may in turn respect your efforts enough to purchase your game instead of pirating it. (Refenes, 2013)

Since the Steam storefront by the Valve corporation is the largest digital distributor of PC games, many of the piracy methods target this platform hence this thesis will only focus on Steam. However, the same principles apply to most other game distributors, most notably Epic Games Store. The third storefront to consider is GOG.com but since it is policy that games must be released without copy protection features, it is not relevant in the discussion of anti-piracy measures. It does however mention an argument that the importance of anti-piracy features might be overstated in the industry since publishers are thriving without them as well.

2.1 Law

The Finnish Copyright Act (Tekijänoikeuslaki) grants copyright-holders exclusive rights to reproduce and distribute their software, online piracy constitutes infringement on these rights (1 §, 2 §). It is also prohibited to circumvent technological protection measures to enable unauthorized copying or distribution (50 a §, 50 b §), this could be interpreted to mean tools used to circumvent DRM (Digital Rights Management) are prohibited. The Copyright Act imposes obligations on online service providers, such as internet service providers and hosting platforms, they are required to take measures to prevent copyright infringement on their platform and to respond to takedown requests from copyright holders (55 c §).

2.2 BitTorrent

The main two methods of sharing illegal content online are through file hosting services, also known as direct download link (DDL) sites, or the BitTorrent protocol.

The BitTorrent protocol is a decentralized file-sharing protocol designed for efficient distribution of large files among a network of peers. It employs a strategy of breaking files into smaller pieces and distributing them among multiple peers, allowing simultaneous uploading and downloading of data. Peers usually connect to a central tracker that facilitates the discovery of other peers in the network, which is distinct from trackers used for discovering specific torrent files. As shown in Figure 1, each node in a peer-to-peer network is connected directly to each other (Cohen, 2003).

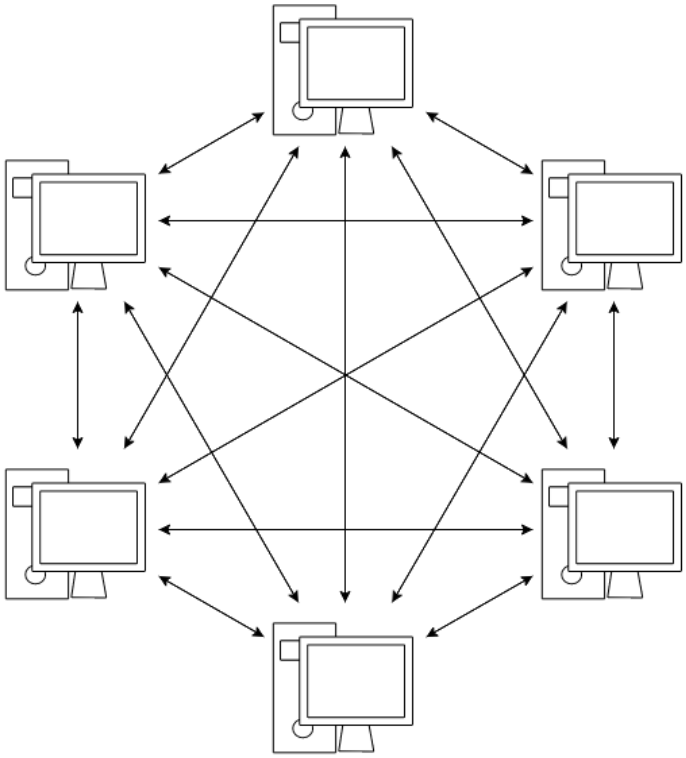

Figure 1. In a peer-to-peer network each node is connected

2.3 Protection against piracy

When you distribute digital content, you will usually want to protect it from being copied. So, you use a copy protection method. When it comes to video games, the most popular

form of prevention is DRM (Digital Rights Management), and anti-tamper solutions. These are commonly both grouped into the term DRM when anti-tamper solutions are implemented to protect the DRM.

A DRM system is used to verify ownership of a digital product. Notable examples are Steam DRM (Steam, n.d.), EA App (Electronic Arts, n.d.) and Ubisoft Connect (Ubisoft, n.d.). These are all based on an account system used to verify ownership of game titles. Because the verification happens through external software, bypassing it is a simple task using off-the-shelf products such as the Goldberg Steam Emulator (Goldberg, 2022).

Anti-tamper solutions are employed to safeguard DRM systems by hindering attempts to bypass or reverse engineer them, ensuring the integrity of the protected software. Based on store data from the Steam storefront (https://store.steampowered.com), which discloses the presence of third-party DRM on game store pages, it can be inferred that Denuvo anti-tamper by Irdeto is one of the prominently utilized anti-tamper solutions within the gaming industry. This conclusion is drawn from the information available on the platform, which indicates the widespread adoption of Denuvo anti-tamper in numerous high-profile titles available on the Steam platform.

While the inner workings of the anti-tamper system are proprietary, the general idea is that the game has certain triggers that activate routines that detect changes in the game files' integrity. This process will consume system resources, but Irdeto claims that only performance non-critical functions are used in the anti-tamper process and would not have any perceptible effect on game performance (Irdeto, n.d.). There have been reports of games including Denuvo protection that are underperforming, in loading times and framerate, for example in titles such as ‘HUMANKIND’ (Amplitude Studios, 2021), ‘Devil May Cry 5’ (Leadbetter, 2019) and ‘Resident Evil Village’ (Leadbetter, 2021).

2.4 Preventing illegal file sharing

There are several organizations worldwide working towards preventing the infringement of copyright, in Finland this is the Copyright Information and Anti-Piracy Centre

(CIAPC) commonly known by their Finnish name and acronym, Tekijänoikeuden tiedotus- ja valvontakeskus (TTVK).

CIAPC will monitor peer-to-peer networks for illegal file sharing. They can see the IP address of the sender of the data and based on this they can apply for a court order by which the internet service provider will be obliged to hand over contact information of the subscriber in question. Based on this information they will contact the account owner by letter to clarify that their network has been used for illegal activity. This often is enough to stop the infringement. If further action is required, it will be considered on a case-by-case basis. (Tekijänoikeuden tiedotus- ja valvontakeskus [TTVK], 2023)

Copyright holders can apply to the court for a blocking order, with which the telecom provider can be obliged to block access to pirate websites that distribute significant amounts of copyrighted material. The individuals managing these sites usually effectively conceal their identity so no direct action can be taken against them, and investigation into it can take a long time. It is often preferable to make the site inaccessible by other means.

2.4.1 Z-Library

Z-library is a digital library that provides a vast collection of books, articles, and other educational resources available for free online.

In a recent ongoing court case in the Eastern District of New York (EDNY), Anton Napolsky, the defendant, was found to have used Amazon Web Services (AWS) to correspond on behalf of Z-Library, which employs AWS Simple Email Service for bookmail.org. The complaint and affidavit filed in the case indicate that email logs obtained from AWS were used to link Napolsky to the operations of Z-library, a website that provides copyrighted books without permission.

FBI agents acting in an undercover capacity have requested copyrighted books from Z-Library using the "send by email" function, and these titles have arrived as attachments to messages from the email address mailer@bookmail.org, which is associated with Z-Library's customer service personnel. (USA v. NAPOLSKY et al, 2022)

Z-Library is currently operational despite most of the domains being seized by the FBI. (Z-Library, 2022)

2.4.2 Finreactor

Finreactor, which was once the most popular BitTorrent tracker in Finland with around 10,000 users, was raided in 2004 following legal action initiated by major software company Microsoft due to a version of the upcoming Longhorn project, later released as Windows Vista, being shared on the site. (Leidenius, 2004)

In 2010, seven operators of Finreactor were ordered by the Supreme Court to pay a total of 680 000 euros in damages to copyright holders. The administrators, some of whom were underage at the time, were considered integral to an illegal network involved in distributing copyrighted files. The legal proceeding continued for several years and resulted in convictions for both individual users and administrators of the site. (Tekijänoikeus, KKO:2010:47, 2010)

2.4.3 The Pirate Bay

The Pirate Bay is one of the most popular piracy sites, boasting over 5 million users with uploads in several dissimilar categories. In a 2013 study, TorrentFreak it was discovered that 75 000 files were uploaded monthly (Van Der Sar, 2014).

In 2006, Swedish authorities conducted a raid, confiscating servers and shutting down the site temporarily. However, The Pirate Bay quickly resurfaced and continued its operations (Van Der Sar, 2007). In 2014, another raid took place, resulting in the seizure of servers and the site's prolonged downtime (TT, 2014). Despite these setbacks, The Pirate Bay managed to make a comeback and remain operational through alternative domains and decentralized hosting methods (Nilsson, 2021).

2.5 Technology used for video game piracy.

For most games there is no need for a game-specific crack, rather the DRM bypass happens on the level of the digital storefront. Since most PC games are sold on Steam, there are several such tools designed for it.

These Steam Emulators replicate the behaviour of the Steam client, making the game function as if it were launched with it. This is typically done through reverse engineering, which involves analysing the Steam client and how it interacts with games, and since the Valve corporation provides these tools for independent publishers to release their games on Steam, a hacker can easily work out how it works. The most basic feature in a Steam emulator is the bypass of authentication but many offer additional functionality such as spoofing entitlement to extra downloadable content, game achievements and online multiplayer if the game supports these features.

For games released with anti-tampering software, a special crack is needed and must be done on a case-by-case basis, due to the complexity of the software there are only a few people claiming proficiency in reverse engineering the anti-tamper solutions (D'Anastasio, 2021).

A substantial portion of games are released without any copy protection, a pirate only needs to acquire the game files to be able to redistribute them. There are large internet communities devoted to sharing game files, both DRM-free and protected.

3 Making a website for distribution of pirated content

Valve Corporation co-founder and president, Gabe Newell, famously said on a panel in 2011; "One thing that we have learned is that piracy is not a pricing issue. It is a service issue. The easiest way to stop piracy is not by putting antipiracy technology to work. It is by giving those people a service that is better than what they are receiving from the pirates." The way pirated media is shared has evolved since then. With the resurgence of more competition in the digital space, it has been harder for the consumer to be loyal to a certain company, for example, there was a long while when Netflix was the clear leader

in streaming services and one subscription could get you most of the movies and TV shows you were interested, but since then several companies have entered the market, with exclusivity deals on the content making it often necessary for the consumer to have multiple subscriptions or cycle through them to get the content they want (Yao, 2023). The same has happened in the video game industry. For a long time, Steam was the only place most gamers purchased games, but as of September 2019, Epic Games had signed 105 exclusivity contracts, amounting to 1 billion 38 million USD ($1 038 000 000), with the intent to get customers to use their platform, alongside offering a free game title every week (Prescott, 2021). This split in where your content is licensed could be a motivator for piracy where you would rather pirate than support these tactics financially. Piracy communities have started to use this to their advantage by providing a simple solution, since loyalty is important for the community to stay afloat, being funded by donations and advertisement revenue.

Within the scope of this thesis, a website has been created with the aim of comprehending the various layers that could potentially be utilized to mitigate piracy in the future, and it mimics other sharing websites. The creation of the website was primarily inspired by 1337x (https://1337x.to) and The Pirate Bay (https://thepiratebay.org), as these websites have gained notoriety for their role in facilitating the illegal sharing and distribution of copyrighted materials. By examining the design and functionality of these websites, as well as analysing the behaviours and motivations of their users, it is possible to gain a better understanding of the factors contributing to piracy.

3.1 Technical decisions: framework and core components

The project is built using Laravel (https://laravel.com), a widely used web application framework written in PHP, for its effective and easy-to-understand syntax, built-in support for common web application features, and strong community support. Laravel's syntax and modular structure make it easy to organize and maintain the codebase, while its built-in support for features such as authentication, routing and database management simplifies the development process. Furthermore, the large and active Laravel community provides a variety of resources and support for developers, making it a reliable and efficient choice for the project.

Most of the configuration options are left at their default values. This approach was taken to reduce development time and complexity, while still adhering to best practices and standards recommended by the framework's documentation and the wider web development community.

3.2 Website structure

The design of this website draws inspiration from other popular torrent-sharing platforms available on the internet. It features pages for browsing, uploading, and viewing torrent files, as well as login and registration pages. However, unlike most torrent websites, this site does not include a user profile page where users can edit their personal information. Non-registered users can still browse and view the torrent files, with the browse page, shown in Figure 2, displaying a list of all uploads. To enhance the user experience, the browse page may offer various sorting and filtering options.

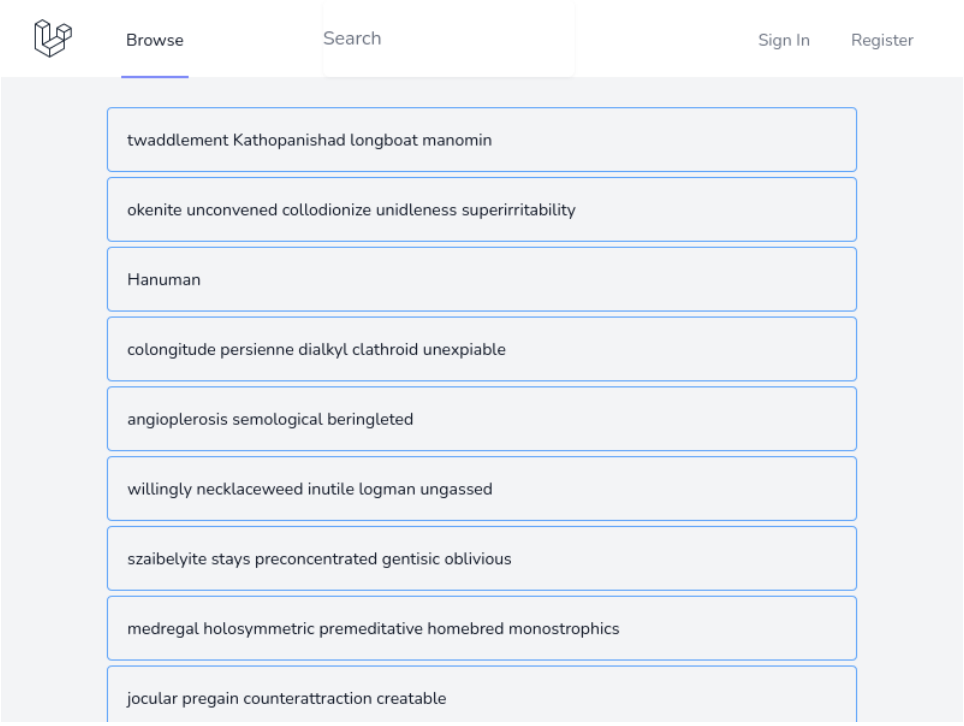

Figure 2. The "browse" section lists all uploaded torrents.

Each torrent file is accompanied by a details page that provides in-depth information about the file, including its description, upload date, size and included files, shown in

Figure 3. If the logged-in user is the uploader of the file, they are provided with the options to delete or edit it. A section where users could leave comments was planned but deemed irrelevant for the purpose of the thesis.

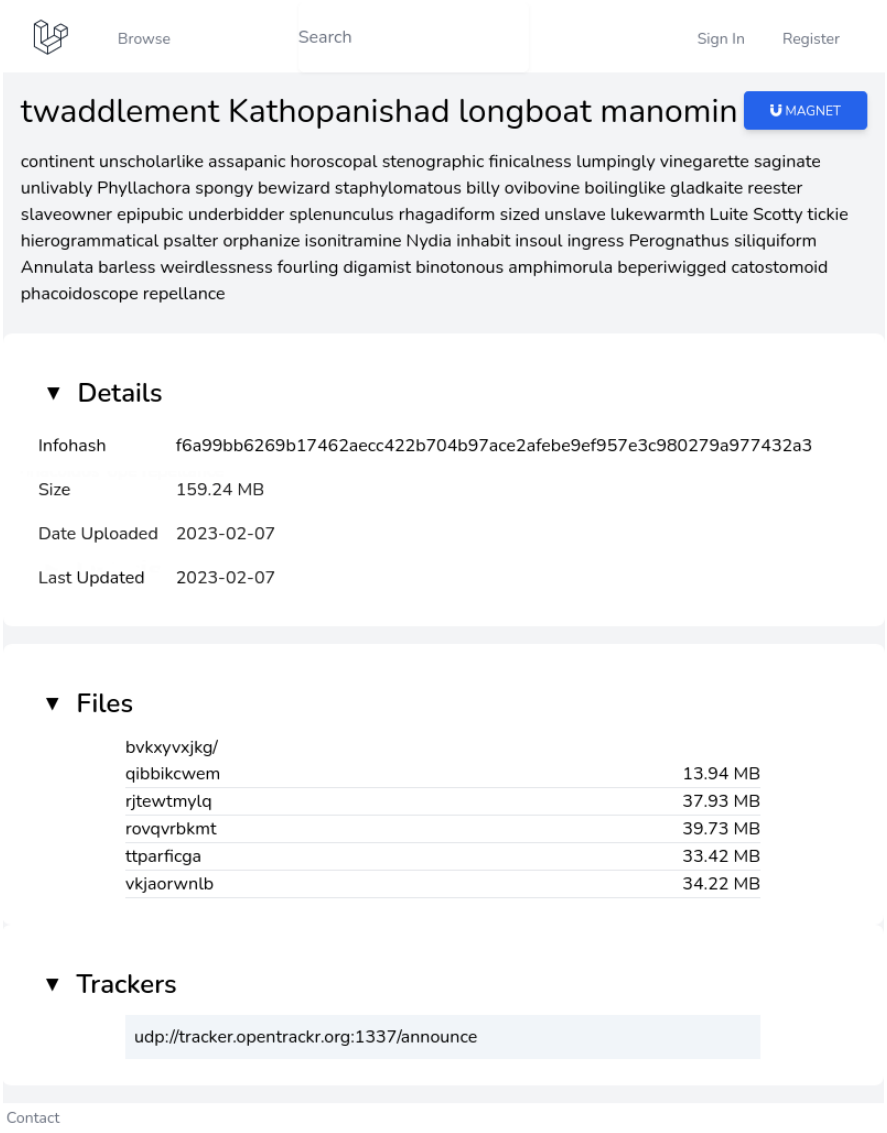

Figure 3. The details page of an entity.

To create a user account, users are directed to the registration page, shown in Figure 4, where they enter their desired username, email address, and password. Upon completing the registration process, users can log in to their account by providing their credentials on the login page. On this website, any registered user can upload files, although it is worth noting that some torrent websites may have a vetting process in place to ensure the trustworthiness of their users.

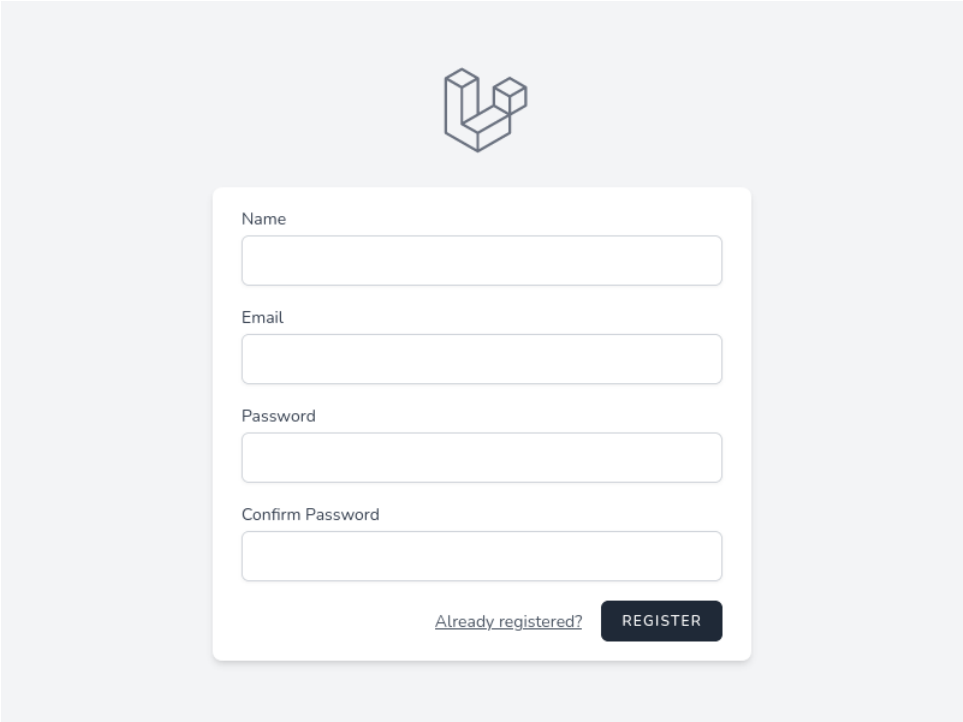

Figure 4. The page for registering a new user account.

Lastly, functional pages exist, including a contact form and a page to change the password of the current account.

3.3 Database structure

The database consists of a few tables, the most prevalent one being ‘games. This table contains information about each game added to the website where each game has a unique ‘id.’ a ‘name,’ and a ‘description.’ The ‘seeds’ and ‘leeches’ fields would track the state of peers on the torrent; however, this is not implemented for the dummy data and is only included as an example. The ‘created_at’ and ‘updated_at’ fields automatically record the creation and last update times of a record. The ‘steam_appid’, ‘eos_id’, ‘gog_id’ and ‘pcgw_id’ fields are for storing a reference to different platforms. The ‘torrent’ field is a binary large object (BLOB) that stores the torrent file of the upload. The ‘creator’ field is a foreign key that references the 'id' field in the ‘users’ table and indicates which user created the game.

The ‘users’ table contains the username, password, and email address of the registered user, as well as a ‘role’ field that could be used to determine if the user has permission to

execute certain tasks, for example, posting and uploading. Like the ‘games’ table, ‘created_at’ and ‘updated at’ fields are used here as well.

The ‘comments’ table stores records of comments left on uploads. its foreign keys are ‘user’ and ‘item’ which are references to the ‘id’ fields of the ‘users’ and ‘games’ table, respectively. A visual representation of the data in the form of an entity relationship diagram can be seen in Figure 5.

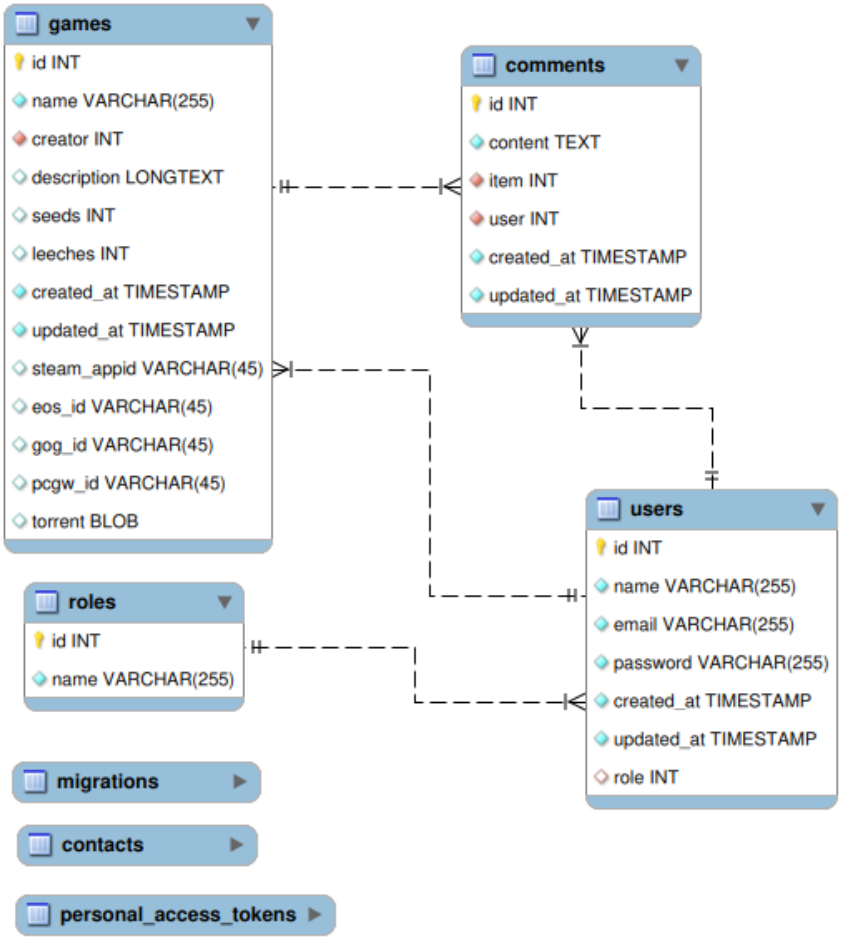

Figure 5. Entity Relationship Diagram (ERD) of the database

4 Results

Registration of an account allows the determination of required user information, for the website created for this thesis, the available information is quite limited. However, some websites in existence may provide a more comprehensive user profile. Streamlined user profiles enhance efficiency and prioritize privacy, while comprehensive profiles offer a

more personalized and engaging user experience. The difference is a matter of personal preference. In a real-world scenario, access to the back end of the website would be unavailable, cross-referencing usernames with other websites is the sole option to seek additional information and tangible evidence indicating the user's identity. Acquiring a court order may enable the collection of more information from the website owner, such as the registered e-mail address. This could be used to request further information from the email provider, and with another court order, to access messages to find personal information and incriminating evidence.

The crucial factors for anonymizing the website created for this thesis would happen during the deployment of the site. To conceal the identity of the site owner, its location and the users accessing it, careful consideration of the hosting provider and domain name registrar is necessary. A viable option is establishing an anonymous company in Seychelles and subsequently registering all domains, servers, and proxies under the new corporation’s name (Sharman, 2010). Nevertheless, it is important to note that this option may be impractical due to its associated costs. In any case, it is important to not reuse any usernames or email addresses for this new site; one can make a new email account just for this site at protonmail.com. To avoid being identified it would be beneficial to use believable but fake personal information and pay with cryptocurrency when registering for services.

To obtain information about the website owner, it may be necessary to contact the domain registrar or website hosting provider. Additional information can potentially be obtained by submitting a contact request through the site's form and conducting similar investigations to those performed on user information, based on the details included in the response to our inquiry.

There can be several so-called points-of-failure when hosting an illegal website, including:

- Domain registration: If law enforcement agencies or cybersecurity professionals manage to uncover the identity of the domain owner, it can lead to the exposure

and potential takedown of the website. However, criminals often use anonymous services and fake information.

- Vulnerabilities and exploits: Like any website, illegal websites can have security vulnerabilities to gain unauthorized access or control over the website. Authorities with the help of cybersecurity researchers and ethical hackers can utilize these methods to potentially compromise the website (Cox, 2015). In the event of a security breach where the attacker gains access to the site's database, email addresses associated with user accounts become crucial information for law enforcement. Unlike platforms that collect extensive personal data, this website was designed to lack additional identifiers. Encrypted passwords, even if compromised, pose less immediate value. However, exposed email addresses serve as a vital link for authorities, offering a starting point in identifying individuals engaged in illicit activities.
- User infiltration: Law enforcement agencies might try to infiltrate illegal communities or undercover agents may pose as users on these websites to gather evidence and identify the individuals behind them. This can lead to the exposure of criminals and their websites (Greenberg, 2014). For the website created for this thesis and others like it, user infiltration is not a concern since the same information is available without an account, signing up just allows the user to upload new content.
- Rivalry: Competing criminals, hacktivists, or concerned individuals may launch DDoS attacks against illegal websites to disrupt their operations or expose their vulnerabilities. Such attacks can render the website inaccessible or unstable, making it difficult for criminals to continue their activities (Singh, 2010). Or revealing personal information (Maxwell, 2018). The website created for the thesis is vulnerable to disruptive DoS attacks as it lacks built-in DDoS protection. Integrating Cloudflare's DDoS mitigation service is a simple and effective solution.
- Cooperation between agencies: International collaboration between law enforcement agencies, cybersecurity firms, and governmental bodies has increased over the years. Sharing intelligence and coordinating efforts can lead to

the identification, tracking, and takedown of illegal websites (Europol, 2014; Peltomäki & Norppa, 2015, p. 164).

When downloading or uploading content over a peer-to-peer network your IP address is added to the so-called swarm, an entity such as a company hired to protect intellectual property can use this information to make a list of addresses that are infringing copyright and demand that the internet service provider provides the contact information for the associated internet subscriber (KKO:2022:47).

If the goal is to apprehend pirates, their identities need to be uncovered first. Since protecting one's identity online is a simple task, it becomes an unreasonable goal for law enforcement.

5 Conclusions

The aim of the thesis was to identify weaknesses in illegal file-sharing websites. The most prominent weakness is security vulnerabilities. With access to a website's database, personal information about the users could be extracted. One would usually at least get an email address for each user, but it might be registered with a provider that is in a country with strict privacy laws, so getting any more personal information could be next to impossible. The same principle applies to the owners and administrators of the website, if they are taking steps to protect their privacy, there is not much one can do.

The website created for this thesis did not provide any new insights into how the distribution of copyrighted material could be mitigated. However, it can provide a better understanding of the structure of torrent sharing websites.

Piracy is a low-stakes crime compared to other cyber threats like cybersex trafficking, narcotics trade, and child pornography. Law enforcement has limited resources to deal with the issue at large. It has led to the entertainment industry, especially the video game industry, taking matters into their own hands and implementing anti-consumer tactics in the form of restrictive digital rights management, these often inconvenience the legitimate user more than the potential pirate.

6 Summary in Swedish

6.1 Introduktion

Piratkopiering innebär olaglig delning av upphovsrättsskyddat elektroniskt material, som musik, filmer, programvara och böcker. Inom datorspelsindustrin är piratkopiering komplicerat på grund av interaktiviteten och starka digitala rättighetssystem (DRM). Det påverkar intäkter och utmanar utvecklare, samtidigt som det väcker frågor om marknadstillgänglighet och effektivitet av åtgärder mot piratism. Metoder för att skapa piratkopior inkluderar att ersätta filer som integrerar spelet i plattformen och manuell reverse engineering vid användning av anti-manipuleringslösningar. Upphovsrättens informations- och övervakningscentral övervakar peer-to-peer-nätverk för att motverka överträdelser och skickar varningar till IP-adressägare. Fokus på att minska tillgängligheten av piratmedia inkluderar att identifiera svagheter hos olagliga fildelningswebbplatser, där användarprofiler kan vara en möjlig svaghet.

6.2 Det aktuella läget för piratkopiering av videospel

Effekterna av piratkopiering i spelindustrin är komplexa och varierande. Vissa förläggare, som CD Projekt RED, lyckas väl utan skydd mot piratkopiering, medan andra som Ubisoft upplever betydande förluster på grund av piratkopiering. Diskussionen om förlorade försäljningar antar att konsumenterna alltid skulle köpa produkten om den olagliga källan inte fanns.

6.2.1 Lagstiftning

Den finska upphovsrättslagen ger exklusiva rättigheter till upphovsrättsinnehavare, förbjuder kringgående av tekniska skyddsåtgärder och ålägger online-tjänsteleverantörer skyldigheter att förhindra upphovsrättsintrång och svara på begäranden om borttagning. (Upphovsrättslag 1 §, 2 §, 50 a §, 50 b §, 50 c §)

6.2.2 BitTorrent

BitTorrent är ett decentraliserat fildelningsprotokoll för effektiv distribution av stora filer mellan peers. Det delar upp filer i bitar, vilket möjliggör samtidig upp- och nedladdning. Klienter ansluter till en central server för att upptäcka andra i nätverket (Cohen, 2003).

6.2.3 Skydd mot piratkopiering

Vid distribution av digitalt innehåll är det viktigt att skydda det från obehörig kopiering, vilket ofta uppnås genom kopieringsskyddsmetoder som DRM (Digital Rights Management) och anti-tamper-lösningar. DRM-system, som Steam DRM (Steam, u.å,), EA app (Electronic Arts, u.å.) och Ubisoft Connect (Ubisoft, u.å.), verifierar ägarskap genom kontosystem, men deras externa verifiering gör det relativt enkelt att kringgå med verktyg som Goldberg Steam Emulator (Goldberg, 2022). Anti-tamper-lösningar, i synnerhet Denuvo, skyddar DRM genom att hindra försök att kringgå eller bakåtkompilera, vilket bevarar programvarans integritet. Denuvo utlöser rutiner som upptäcker förändringar i spelfilernas integritet, vilket påverkar systemresurserna. Trots Irdetos påståenden om icke-kritiska prestandaeffekter (Irdeto, u.å,), tyder rapporter på att spel med Denuvo, som "HUMANKIND" (Amplitude Studios, 2021), "Devil May Cry 5" (Leadbetter, 2019) och "Resident Evil Village" (Leadbetter, 2021), kan uppleva underprestanda vad gäller laddningstider och framerate.

6.2.4 Förhindrande av olaglig fildelning

I Finland övervakar Upphovsrättens informations- och övervakningscentral r.f. (TTVK) aktivt peer-to-peer-nätverk för olaglig fildelning. De identifierar IP-adresser till de som skickar data och kan få domstolsbeslut för att tvinga internetleverantörer att lämna ut abonnentinformation. CIAPC kontaktar sedan kontoägaren och löser ofta problemet genom varningar. Vid behov övervägs ytterligare åtgärder från fall till fall. Dessutom kan upphovsrättsinnehavare ansöka om domstolsbeslut för att blockera telekomleverantörernas tillgång till piratwebbplatser som distribuerar upphovsrättsskyddat material, eftersom direkta åtgärder mot webbplatsansvariga är svåra på grund av deras dolda identiteter och långdragna utredningar. Denna metod syftar till att göra sådana webbplatser otillgängliga (TTVK, 2023).

6.2.5 Fallstudier av Z-Library, Finreactor och The Pirate Bay

Z-Library, Finreactor och The Pirate Bay har alla ställts inför rättsliga utmaningar på grund av sina kopplingar till olaglig distribution av upphovsrättsskyddat material. Z-Library befinner sig i en pågående rättslig granskning i Eastern District of New York, där dess användning av Amazon Web Services (AWS) kunde länkas direkt till delning av upphovsrättsskyddade böcker. Trots FBI:s åtgärder fortsätter Z-Library att vara aktiv (USA v. NAPOLSKY et al, 2022; Z-Library, 2022). Finreactor, en tidigare ledande BitTorrent-tracker i Finland, drabbades av rättsliga åtgärder initierade av Microsoft efter att ha delat en version av Longhorn-projektet. Rättsprocessen resulterade i betydande skadestånd och fällande domar för operatörer (Leidenius, 2004; Tekijänoikeus, KKO:2010:47, 2010). The Pirate Bay, en ökänd piratkopieringssajt, har överlevt flera razzior och driftstopp genom att anpassa sig med alternativa domäner och decentraliserade hosting-metorder (Nilsson, 2021).

6.3 Teknik som används för piratkopiering av videospel.

De flesta PC-spel, som ofta säljs på plattformar som Steam, kan crackas utan att det behövs några spelspecifika cracks. Steam-emulatorer replikerar Steam-klientens beteende, vilket uppnås genom reverse engineering och analys av hur Steam interagerar med spel. Eftersom Valve tillhandahåller dessa verktyg för utgivare på Steam kan hackare enkelt förstå och efterlikna processen. Grundläggande funktioner i Steam-emulatorer inkluderar autentiseringsbypass, och vissa erbjuder ytterligare funktioner som att förfalska rätten till extra innehåll, prestationer och online-multiplayer om spelet stöder dessa funktioner. Spel med antimanipuleringsprogramvara kräver specialiserade cracks, som skapas från fall till fall på grund av programvarans komplexitet. En undergrupp av spel släpps utan kopieringsskydd, vilket gör det möjligt för pirater att omfördela dem genom att förvärva spelfilerna. Onlinegemenskaper är vanliga för att dela både DRM-fria och skyddade spelfiler.

6.4 Skapande av en webbplats för distribution av piratkopierat innehåll

I samband med detta lärdomsprov har en webbplats skapats för att utforska lager för potentiell minskning av piratkopiering, med inspiration från ökända plattformar som 1337x (https://1337x.to) och The Pirate Bay (https://thepiratebay.org). Genom att studera deras design, funktionalitet och användarbeteenden är målet att förstå de bidragande faktorerna till piratkopiering.

6.4.1 Tekniska beslut: ramverk och huvudkomponenter

Projektet är utvecklat med Laravel (https.//laravel.com), ett ramverk för webbapplikationer som är känt för sin tydliga syntax, inbyggda stöd för vanliga webbapplikationsfunktioner och robusta community. Laravels syntax och modulära struktur underlättar kodorganisation och underhåll, medan dess inbyggda stöd för viktiga funktioner som autentisering, routing och databashantering effektiviserar utvecklingsprocessen. Projektet drar nytta av Laravels omfattande och aktiva community, vilket säkerställer tillgång till en mängd resurser och utvecklarstöd. Genom att utnyttja Laravels kapacitet strävar utvecklingsteamet efter att skapa en tillförlitlig och effektiv lösning. När det gäller konfiguration behåller projektet i stort sett standardinställningarna, ett strategiskt val för att minimera utvecklingstiden och komplexiteten. Detta beslut ligger i linje med bästa praxis och standarder som rekommenderas av ramverkets dokumentation och den bredare webbutvecklingsgemenskapen.

6.4.2 Webbsidans struktur

Webbplatsens design hämtar inspiration från populära torrentdelningsplattformar och erbjuder sidor för att bläddra, ladda upp och visa torrentfiler, tillsammans med inloggnings- och registreringsfunktioner.

Varje torrentfil har en detaljsida med omfattande information som beskrivning, uppladdningsdatum, storlek och inkluderade filer. Om den inloggade användaren är uppladdaren har de alternativ för att ta bort eller redigera filen. Användare kan skapa konton via registreringssidan genom att ange önskat användarnamn, e-postadress och

lösenord. Efter registrering kan användarna logga in på sina konton på inloggningssidan. Alla registrerade användare kan ladda upp filer, men vissa torrentwebbplatser kan ha en process för att kontrollera användarnas pålitlighet.

Funktionella sidor inkluderar ett kontaktformulär och en sida för att ändra lösenord för det aktuella kontot, vilket förbättrar användarinteraktionen och säkerheten.

6.4.3 Databasens struktur

Databasen är strukturerad med en primär "games"-tabell som innehåller unika spelposter som identifieras med "id", "name" och "description". Även om fälten "seeds" och "leeches" finns för att spåra torrent-peers, är de inte implementerade i dummy-data. Fälten "created_at" och "updated_at" loggar automatiskt tider för skapande och uppdatering. Plattformsreferenser ("steam_appid", "eos_id", "gog_id", "pcgw_id") och ett "torrent"-fält som lagrar torrentfiler ingår. Fältet "creator", en främmande nyckel, länkar till "id" i tabellen "users" och anger den användare som skapade spelet.

Tabellen "users" innehåller registrerade användardata, med användarnamn, lösenord, e-postadress och ett "role"-fält för uppgiftsbehörigheter. I likhet med "games" registrerar fälten "created_at" och "updated_at" tidsstämplar.

Tabellen "comments" loggar kommentarer om uppladdningar, med främmande nycklar för "user" och "item" som refererar till "id" i tabellerna "users" respektive "games". Denna arkitektur skapar en relationsstruktur för effektiv hantering av användar-, spel- och kommentardata.

6.5 Resultat

Genom att registrera ett konto på en webbplats kan man bestämma vilken användarinformation som krävs. Vissa webbplatser erbjuder omfattande användarprofiler, medan andra fokuserar på integritet och effektivitet. För att söka ytterligare information och bevis om användarens identitet kan man korsreferera användarnamn med andra webbplatser och vid behov begära domstolsbeslut för tillgång

till mer information.

Viktiga faktorer för anonymisering av en webbplats är att välja rätt hostingleverantör och domännamnsregistrerare samt att använda anonyma tjänster och betala med kryptovaluta.

Precis som alla andra webbplatser kan olagliga webbplatser ha säkerhetsproblem som gör att obehöriga kan få åtkomst till eller kontroll över webbplatsen. Myndigheter kan med hjälp av cybersäkerhetsforskare och etiska hackare använda dessa metoder för att potentiellt kompromettera webbplatsen (Cox, 2015). I händelse av ett säkerhetsintrång där angriparen får tillgång till webbplatsens databas blir e-postadresser som är kopplade till användarkonton avgörande information för brottsbekämpning. Till skillnad från plattformar som samlar in omfattande personuppgifter var den här webbplatsen utformad för att sakna ytterligare identifierare. Krypterade lösenord, även om de kompromettеras, utgör ett mindre omedelbart värde. Men exponerade e-postadresser fungerar som en viktig länk för myndigheterna och erbjuder en startpunkt för att identifiera personer som är inblandade i olaglig verksamhet.

6.6 Avslutning

Lärdomsprovet handlar om svagheter i illegala fildelningswebbplatser, där den främsta svagheten är säkerhetsbrister som gör att personlig information kan extraheras från webbplatsens databas. Det kan vara svårt att få tag på mer personlig information om användarna om deras e-postadresser är registrerade hos leverantörer i länder med strikta sekretesslagar. Samma gäller för webbplatsens ägare och administratörer, så länge de skyddar sin integritet. En webbplats som skapades för att studera dessa svagheter gav inte ny information om hur distribueringen av upphovsrättsskyddat material kan minskas, men den gav en bättre förståelse för strukturen hos webbplatser för torrentdelning. Polisen har begränsade resurser för att hantera piratkopiering, vilket har lett till att underhållningsindustrin har tagit egna åtgärder i form av restriktiva digitala rättighetshanteringsmetoder. Dessa metoder är ofta besvärligare för den legitima användaren än för piraterna.

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