# How the Gaming Community is Growing A Social Network Analysis

Farbod Behnaminia, Jaykumar Patel, Zannatul Ferdoush, Madhavkumar Bhavikbhai Sheladiya

***Abstract*—Network analysis on social platforms focused on virtual games (all varieties) will allow us to decide how rapidly the gaming community is rising and evolving. Through this project, we can figure out the factors driving the changes in the gaming community. A comparison of users before and after the pandemic will also allow us to decide how big or small roles home quarantine and lockdown play in the world of gaming.**

**Gaming community analysis can be applied in a variety of ways. Game development is one application of analysis in the gaming world. Game developers can examine their users' preferences to see what they enjoy and detest the most while playing a game. The game recommendation system is another simple application for the bulk of players who are unsure what to play next out of thousands of games available to them.**

**To reach the study's goal, we have conducted a thorough analysis of existing literature in the gaming community and social network analysis to find the state-of-the-art methods and problem areas. Following a literature review, this study will assess the various data collection and storage options available. We will use API to collect data from a popular social media platform, Twitter, as well as user statistic data from SteamDB. This study will develop models and schema to demonstrate outcomes after obtaining and storing data.**

***Index Terms*—Social Network Analysis, Multiplayer Gaming, Community Detection, Classification**

## I. Introduction

ON December 31st, 2019, the World Health Organization (WHO) was alerted about instances of pneumonia of unknown etiology in Wuhan City, China. Authorities in China announced the discovery of a new coronavirus, which they named "2019-nCoV," on January 7, 2020. Infectious disorders caused by Coronaviruses (CoV) range from the common cold to more severe conditions. Humans have not before been infected with a novel coronavirus (nCoV). In an effort to promptly discover any new 2019-nCoV cases, countries throughout the world have ramped up their monitoring. Some governments and health organizations have created contact tracing programs to track down contacts when a COVID-19 patient is identified [1].

According to the WHO Coronavirus (COVID-19) Dashboard, globally, as of 4:59pm CEST, 1 April 2022, there have been more than 486 million confirmed cases of COVID-19, including more than 6 million deaths, reported to WHO [2].

Some preventative precautions have been taken such as maintaining a safe distance from sick people, quarantining them in a separate area, and washing hands often and avoiding touching face with dirty hands. In order to reduce the spread of disease, wearing a face mask or other protective covering has been advocated in public places.

With more than 3.9 billion individuals in more than 90 nations or territories under lockdown by April 2020, almost half of the world's population was under some sort of lockdown (By Alasdair Sandford & Euronews). Lockdowns were imposed in various nations during 2020 and 2021, starting in March in Hubei province, China and countrywide in Italy. India's 1.3 billion people were told to remain home on March 24, 2020, making it the pandemic's greatest lockdown. It was 234 days in Buenos Aires, Argentina in 2020, whereas Melbourne, Australia had the highest cumulative lockdown days at 267 days as of October 2021.

The pandemic has halted everything from work and school to medical treatments and travel. We put off decisions and goals until we can un-pause our life. During the pandemic, "boredom" became a code term for feeling detached, lifeless, or boring. COVID-boredom magnifies our loss of interest to the point that everyday living appears to be an existential sickness (Julian Jason Haladyn Assistant Professor of Art History, OCAD University).

During the COVID-19 pandemic, playing video games improved participants' sense of well-being. As a stress reliever and brain stimulant, video games have helped people cope with the consequences of lockdown by keeping them socially connected and occupied [3]. As the number of participants in the market grew and new firms joined during the pandemic, the sector's growth rate climbed. There were more over 20 million concurrent players on Steam, a significant game distributor during the epidemic. This figure is steadily rising. As the number of participants has risen, so have the games and activities that firms create to accommodate it.

Online gaming allows people to pass the time as well as communicate with their friends. A large number of early gamers experimented with multiplayer gaming and found it to be enjoyable. There are many other genres to choose from, including role-playing games, action games, adventure games, open-world games, mystery games, horror games, fantasy games, first-person shooter games, and more. There are many different sorts of games to choose from, including multiplayer, online, single-player, cooperative, and team games, among others. Analysis of users for a range of games and a variety of game creating organizations may provide exact data, and we may be able to draw conclusions about the influence of COVID-19 on the gaming community as a whole. "In the broadest sense, a gaming community is an online community that is centered on interaction through game. A computer game, in this context, will mean something that one uses primarily as for a hobby, a diversion from real life, and is a medium through which one plays" [4]. The primary reason to have a community centered on a game is so that its members'

playing experience is enriched. There are various trends on Twitter (a social networking service), we cannot cover all of them, so we focused on a few selected hashtags like #gaming, #pubg and #csgo to do our research.

Let us have an Introduction to different game launchers.

- **Steam**: Valve's Steam is a digital distribution service and storefront for video games. In September 2003, it was released as a separate software client as a tool for Valve to give automatic updates for its games, and it later extended to distribute and market titles from third-party game publishers. Digital rights management (DRM), game server matchmaking and anti-cheat measures, as well as social networking and game streaming services, are all available through Steam. It offers automatic game updates, cloud synchronization of saved games, and community features, including friend messaging, in-game chat, and a community market. Steam is the most popular digital distribution channel for PC games, accounting for over 75% of the market in 2013 [5]. By 2017, Steam users had spent around US$4.3 billion on games, accounting for at least 18% of global PC game sales [6]. The service had over 34,000 games and 95 million monthly active users by 2019. Some of the top titles on Steam 2021 [7] : Battlefield 2042, Counter-Strike: Global Offensive, PUBG, Dead by Daylight, Destiny 2, New World, Tom Clancy's Rainbow Six: Siege, DOTA 2, Grand Theft Auto 5.
- **Origin**: Electronic Arts created Origin, a digital distribution platform for buying and playing video games. The software client for the platform is accessible for both personal computers and mobile devices. Origin has social features such as profile management, networking with friends via chat and direct game joining, streaming via Twitch and game library sharing, and community interaction with social networking sites such as Facebook, Xbox Live, PlayStation Network, and Nintendo Network [8]. Electronic Arts indicated in 2011 that it wanted Origin to compete with Valve's Steam service by introducing cloud game saves, auto-patching, achievements, and cross-platform releases [9]. Origin has approximately 50 million registered users by 2013 [10]. Some of the top titles on Origin 2021 [11] : Knockout City, Biomutant, Mass Effect, It Takes Two, Apex Legends.
- **Activision Blizzard**: Activision Blizzard, Inc. is a Santa Monica, California-based video game holding corporation [12]. Activision, Inc. (the publicly traded parent company of Activision Publishing) and Vivendi Games merged in July 2008 to form Activision Publishing. In terms of sales and market value, it was the largest game company in the Americas and Europe as of March 2018 [13]. In its first 24 hours, Activision Blizzard's Call of Duty: Modern Warfare 3 grossed $400 million in the United States and the United Kingdom, making it the most successful entertainment launch of all time [14]. Some popular titles available on Activision Blizzard : Call of Duty, Crash Bandicoot, Guitar Hero, Tony Hawk's, Spyro, Skylanders, World of Warcraft, StarCraft, Diablo, Hearthstone, Heroes of the Storm, Overwatch.
- **Epic Games**: Epic Games operates the Epic Games Store, a digital video game retailer for Microsoft Windows and macOS. It debuted in December 2018 as a website as well as a standalone launcher, the latter of which is required to download and play games. A minimal catalogue, friends list management, matchmaking, and other services are available on the storefront [15]. Epic Games intends to enhance the storefront's feature set in the future, but it will not offer as many features as other digital distribution platforms, such as discussion boards or user reviews, instead relying on existing social media platforms to do so. Epic Games recruited developers and publishers to the service by promising time-exclusive publishing agreements in exchange for guaranteed minimum revenue, even if Epic lost money on underperforming games. To attract customers, Epic also offered one or two free games per week for the first two years of its business. Some of the best titles on Epic Games [16] : Rocket League, Subnautica, Ashen, Metro Exodus, Hades, Unreal Tournament, Dauntless, The Witness.

The online gaming platform, Steam, was first released by the Valve Corporation in 2003. What started as a small platform for Valve to provide updates to its games has turned into the most prominent computer gaming platform globally. The platform initially released just seven games in 2004, but this number has progressively risen in the ensuing years, reaching a staggering 10,696 in 2021, up from 9,609 in 2020. In the first two months of 2022, 1,514 titles have been released on the platform so far. Steam's PC dominance [17]. When you think of PC gaming, you automatically think of Steam. With such a wide range of games on offer, from traditional online multiplayer shooters to farming simulators, there is something for every gaming taste on the platform. As a result, gamers flock to Steam in their millions, registering over 25.47 million peak concurrent users in May 2021. The wide range can see the global nature of the platform of languages its users speak. While English remains the dominant language, almost a third of Steam users in 2021 stated that their primary language was Chinese or Russian [17]. Steam's most prominent game, *Counter Strike: Global Offensive*, was the most popular game on Steam in 2021. The first-person shooter averaged almost 605 thousand players per hour, more than 30 percent more users than its closest competitor, DOTA 2. The game also topped the 2021 list for the peak number of concurrent players - *CS: GO* reached almost 1.2 million players in a single hour at its peak, with New World claiming second place [17].

To perform a proper analysis, we can compare user count of some consistently popular games like CS:GO and PUBG. This study will examine the pandemic's impact on the game industry and major partners of the game industry.

The following is the report's structure: II. Literature Review, III. Methodology, IV. Experimental Analysis, V. Conclusion & Future Work.

## II. Relevant Literature Review

There exist some previous works on how gaming can affect socializing among young generations and how it can shape the pattern of their behaviour. In [18] Authors specifically talked about the Fortnite game as a case study. They considered psycho-social characteristics that are the most affecting for predicting Fortnite micro-transaction spending. They intended to study the impact of cognitive and social elements on a player's micro-transaction spending. Also, they debated how much the purchase of Fortnite micro-transactions is linked to the symptomatology of gaming disorder. Participants were found through Fortnite-related web forums (e.g., Epic Games, Reddit forums). From November through December 2018, responses were obtained. A total of 839 people visited the survey link; 301 left without responding to questions, and 108 left before completing it. Gender, age, nationality, and annual income were among the demographic details provided by participants (ranges provided). To address potential multi-collinearity in studies conducted, they employed the elastic net, a new penalized regression technique that picks the most relevant predictors and penalizes coefficients. Overall, the penalized regression revealed that the following factors were the most relevant predictors of expenditure: frequency of spending by the participant's closest friend who does Fortnite expenditures; older age; more payment methods; and weekly time spent playing Fortnite.

In another study [19], authors intended to provide an overview of the gaming market's rapid emergence and the number of players in the selected nation in Eastern Asia, Western Europe, and North America during the period 2017–2019. Based on the data for the countries per area covered in this study, economic factors such as income per capita, internet population, and Google trends interest in e-sports indicators have substantially influenced the increase in games sales and total players growth.

In Ref. [20] the authors asked about what effects the epidemic had on the players' social ties and habits of interaction. Covid-19's effect on player loyalty and sociality was examined across three distinct geographic locations (i.e., Europe, North America, and South Korea) using data from a year of online multiplayer gaming called "League of Legends". Although their results showed very close link between the development of Covid-19 restrictions and player activity, they examined users in specific regions.

Another study [21], reported a social network analysis of how Pokémon Go has been reflected and represented in the Twitter. They found that this game made people more social and made them talk more with each other. It also found that users were more social, explored their surroundings more, and made their routines more meaningful because of their social behavior.

## III. Project Details & Methodology

To begin, data including gaming hashtags is collected from Twitter Academic Research API [22], and then the data must be cleaned before processing. We decided to use R programming language [23] for our data analysis work which

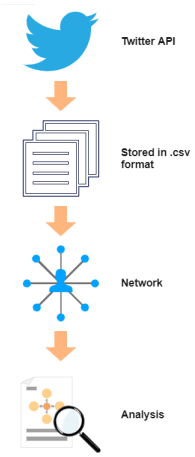


Fig. 1. Data collected using Tweepty [28] in .csv format [29] and visualized as a network with the help of igraph library [30] using R language [23] for further analysis

made available under the GNU GPL v2 license [24].
R is an open-source programming language [23] for statistical computation and graphics that is used in R analytics. Statistical analysis and data mining are common uses for this programming language. R may be used to analyze businesses' data, but it can also be utilized in the construction and design of statistical analysis software applications [25]. Python [26] and R [23] are the two best high-end data science tools. Python is easier to learn than R, but it does not have as many libraries for Econometrics and other important topics in data science as the latter does [27].

### A. Architecture

We have shown in Fig. 1 the hierarchy of fetching data from the Twitter for non-commercial analysis. Then we planned to find communities using social network analysis and interpret them. Firstly we needed data ranging January 2020 and April 2020, which is not possible to collect using Twitter API Essential access, for this we requested for Twitter API Academic access [22] which allows us to fetch data from anytime since 2006. Once we had Twitter API Academic access, we used Python programming language [26] to fetch 3000 tweets for each #gaming, #pubg, #csgo. The data was collected in two groups for each hashtag, 1500 tweets from Jan 2020 - Feb 2020 and 1500 tweets from March 2020 - April 2020 making a total of 6 datasets of 1500 tweets each. This data was stored in CSV format [29]. The collected data was then filtered out by discarding users with less than 2 follower and tweets who had less than 2 retweets. We then used this filtered data to plot a network using R programming language [23] with the help of igraph library [30] which is available in R. Networks were plotted for all the datasets we had and compared the density, average degree and centrality measures of each hashtag from before and during lockdown to find any changes in gaming communities.

TABLE I
DEGREE, DENSITY, AND CENTRALITY MEASURES FOR EACH DATASET - BEFORE AND AFTER THE LOCKDOWN PERIOD

| Hashtags | Degree : Max | Degree : Avg | Density | Betweenness Centrality | Closeness Centrality | Degree Centrality | Eigenvector Centrality |
|---|---|---|---|---|---|---|---|
| #PUBG Before | 53 | 2 | 0.003087923 | 170521749 | 698.0014 | 487902 | 698 |
| #PUBG After | 65 | 2.5 | 0.003244928 | 861122999 | 1198.001 | 1436402 | 1198 |
| #CSGO Before | 23 | 1.875 | 0.002392244 | 170521749 | 698.0014 | 487902 | 698 |
| #CSGO After | 37 | 3 | 0.002504792 | 498002499 | 998.001 | 997002 | 998 |
| #Gaming Before | 17 | 1.75 | 0.0007068512 | 254721999 | 798.0013 | 637602 | 798 |
| #Gaming After | 59 | 3.5 | 0.0007292663 | 1683003749 | 1498.001 | 2245502 | 1498 |

## IV. Experimental setup and demonstration

During the early outbreak of the global COVID-19 epidemic, gaming quickly became one of the most popular activities [31]. Gen Z and millennials, in particular, spent more time gaming since it was a convenient way to spend time amid initial stay-at-home orders, lockdowns, and social distancing [32]. Our research focuses on assessing this growth of gamers during the epidemic's early stages using social media data. Online social media platforms allow people worldwide to engage with one another and create relationships based on shared interests [33]. Our study employs data from the social media platform Twitter to examine how a real-life event, such as the COVID-19 epidemic, has caused people with similar interests to gravitate toward one another and establish online gaming communities or clusters. We used gaming related hashtags to identify common interests between users and community detection algorithm to find networks with many degrees (connections) to observe how the gaming community grew over time. The next subsections detail the procedures for data collection and preprocessing, experimental analysis, and discussion of our findings.

### A. Implementation Details

We employed data mining to gather the Twitter data as we could not find any open-source gaming-related dataset for the period of the start of the COVID-19 outbreak. To do so, we first created a developer account and registered our app under the Academic Research [22] stream on Twitter to get access to older Twitter data. Then we utilized Tweepy [28], an open-source Python package, to access the Twitter API. Tweepy comes with a set of classes and methods representing Twitter's models and API endpoints, and it transparently handles implementation concerns like data encoding and decoding. Finally, we identified and collected information of Twitter users who used three popular gaming-related hashtags, #PUBG, #CSGO, and #gaming, to communicate with their networks between January 2020 and April 2020, when the pandemic's first wave spread over the world [34].

The unique user id, date of creation, follower count, and retweet count are the main attributes in the collected dataset. To preprocess our data, we removed the rows having empty or null values. We also filtered users who have at least two friends as well as whose tweets have been retweeted at least twice to ensure that there is at least some social activity between the users. Finally, we collected 3000 Twitter user data for each of the hashtags from January to April 2020 in our dataset and we saved in our local computer.

We then divided our datasets for each hashtag into two parts: ***Set A***, which contains the data for January to February 2020, and ***Set B***, which has data for March to April 2020. We then created two network graphs comparing ***Set A*** and ***Set B*** users using the *igraph package* in R programming language to see what difference the pandemic's growth and restriction have made in the gaming communities. We further derived the degrees and centrality data of the two networks to gain additional insights. Our experiments were carried out on a computer equipped with an 8-core CPU, 8GB unified memory, and a 16-core Neural Engine.

### B. Results

In Table I we gathered our results of different degrees and centrality values of our simulated networks. It can be observed that we had a rise in the different centrality measures after the lockdown. Fig. 4 and Fig. 5 shows the difference in how the gaming community has grown denser over time as we approached lockdown from March 2020. From the degree of the nodes and centrality values, we can interpret that gamers generally contacted each other more than before and formed more condensed social clusters during the lockdown (shown in Fig. 5).

To compare our findings, we collected data from Steam [34] which is one of the largest gaming platform and Fig. 2 shows the weekly average of the number of people actively playing on Steam from 2004-01-01 to 2022-01-01, as well as the number of players online but not playing on Steam. The weekly average is used to make the graph clearer. The data is displayed as of 00:00 UTC time. Although the number of instant active Steam users never exceeded the limit of 20 million before lockdown, it rarely fell below 20 million after March 2020 (the first month of lockdown in most countries), and the average number of instant users until December 2020 is 20.4 million, as shown in Fig. 3. While the average number of players regularly playing games was 4.4 million in 2019, that number climbed by 25% to 5.5 million in 2020.

### C. Discussion

It is a common saying that people in this world naturally tend to form groups, regardless of their circumstances. People always come up with new ways to socialize and communicate. During the COVID-19-time, people were confined to their

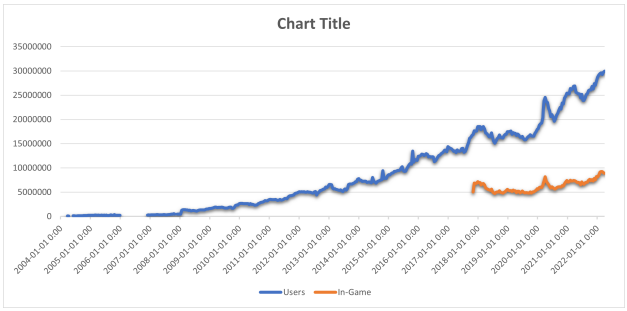


Fig. 2. Chart made using data from SteamDB [34] shows population of active users on steam from 2004-01-01 till 2022-01-01

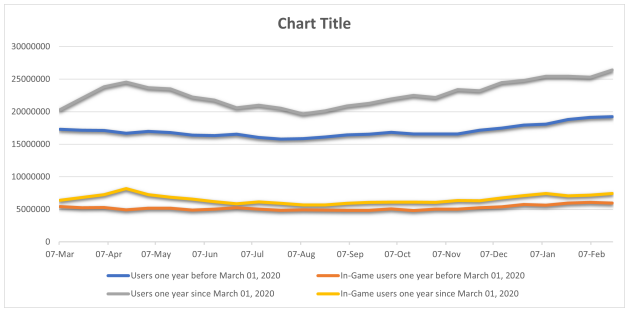


Fig. 3. Chart showing active users and in-game users on Steam [34] one year before and one year since lockdown

houses. Consequently, some of them began to play internet games and socialize. We can also anticipate that as more people continuously join the gaming community, this industry will continue to grow indefinitely. Analysis may be utilized to build a simple web application that shows trending, top 5, top trending of the month, or top trending of the year game in each genre, allowing gamers to narrow down their options and choose one to play.

Fig. 4. Network graph for Twitter users using #gaming from January 2020 - February 2020

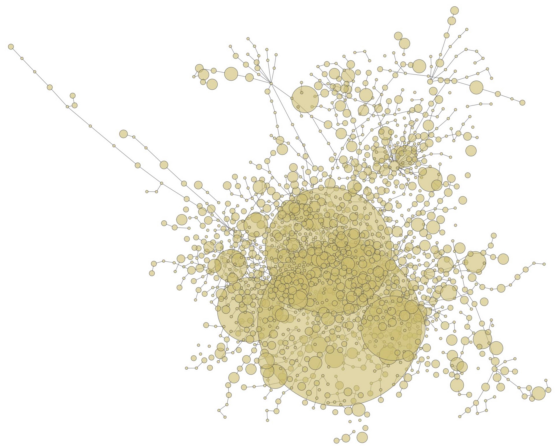

Fig. 5. Network graph for Twitter users using #gaming from March 2020 - April 2020

## V. Conclusion & Future Works

According to the analysis results, we can conclude that people started to play more intensely during the lockdown period. Notably, people were more likely to play popular games like PUBG (Player unknown's Battlegrounds) and CSGO (Counterstrike: Global Offensive). From this analysis, we can also state that people formed a gaming community to socialize with strangers during this period. Our results from the steam analysis also showed that the gaming industry took a quick rise after the lockdown was imposed.

As future works, firstly, we would like to collect data on gaming companies' stock prices and analyze their revenue. Second, we aim to apply the link prediction notion to create a game recommendation system for new and veteran players.

## Acknowledgment

The authors would like to express their gratitude to Dr. Pooya Moradian Zadeh, the course instructor, for his insightful remarks, which helped to elevate the quality of this work.

## References

[1] *Pneumonia of unknown cause – China*. [Online]. Available: https://www.who.int/emergencies/disease-outbreak-news/item/2020-DON229.

[2] *WHO Coronavirus (COVID-19) Dashboard*. [Online]. Available: https://covid19.who.int.

[3] M. Barr and A. Copeland-Stewart, "Playing video games during the covid-19 pandemic and effects on players' well-being," *Games and Culture*, vol. 17, no. 1, pp. 122–139, 2022.

[4] *Online-gaming-communities*. [Online]. Available: https://cs.stanford.edu/people/eroberts/cs181/projects/2004-05/online-governance/online-gaming-communities/online-gaming-communities.html (visited on 04/15/2022).

[5] W. Balmford, "Collecting, displaying and not playing: Steam sales and digital game collections," 2020.

[6] D. Bailey, "With $4.3 billion in sales, 2017 was steams biggest year yet," *URL: https://www. pcgamesn. com/steam-revenue-2017*, 2018.

[7] K. Campbell, *Here are steam's most popular games of 2021*, 2021. [Online]. Available: https://ftw.usatoday.com/2021/12/steam-most-popular-games-2021.

[8] T. Teeter and R. Lunsford, "Electronic arts: Strategic differentiation in the global video gaming industry," in *RAIS Conference Proceedings-The 14th International RAIS Conference on Social Sciences and Humanities*, 2019.

[9] R. Dylewski and J. Adamczyk, "Economic and environmental benefits of thermal insulation of building external walls," *Building and Environment*, vol. 46, no. 12, pp. 2615–2623, 2011.

[10] M. Jackson, *Ea origin passes 50 million users milestone*, 2013. [Online]. Available: https://n4g.com/news/1316817/ea-origin-passes-50-million-users-milestone.

[11] R. Zane, *5 best games on origin access you have to play in 2021*, 2021. [Online]. Available: https://techyhost.com/best-games-on-origin-access/.

[12] E. TARVER, *Top 4 mutual fund holders of activision blizzard (atvi)*, 2022. [Online]. Available: https://www.investopedia.com/articles/investing/031516/top-5-mutual-fund-holders-activision-blizzard-atvi-focpx.asp.

[13] jon jordan, *Earnings report roundup: Game industry winners and losers in q4 2017*, 2018. [Online]. Available: https://www.gamedeveloper.com/business/earnings-report-roundup-game-industry-winners-and-losers-in-q4-2017.

[14] B. Crecente, "Call of duty: Modern warfare 3 shatters all sales records, nears half a billion dollars in day one sales," *för Kotaktu, uppdaterad*, pp. 11–11, 2011.

[15] *Most successful videogame engine*, 2014. [Online]. Available: https://web.archive.org/web/20151222151655/http://www.guinnessworldrecords.com/world-records/most-successful-game-engine.

[16] T. STAFF, *Best games you can get on the epic store*, 2022. [Online]. Available: https://www.thegamer.com/best-games-epic-store/.

[17] *Statista - The Statistics Portal*. [Online]. Available: https://www.statista.com/.

[18] D. L. King, A. M. Russell, P. H. Delfabbro, and D. Polisena, "Fortnite microtransaction spending was associated with peers' purchasing behaviors but not gaming disorder symptoms," *Addictive Behaviors*, vol. 104, p. 106 311, 2020.

[19] J. M. Palma-Ruiz, A. Torres-Toukoumidis, S. E. González-Moreno, and H. G. Valles-Baca, "An overview of the gaming industry across nations: Using analytics with power bi to forecast and identify key influencers," *Heliyon*, e08959, 2022.

[20] S. Petrosino, E. Loria, and J. Pirker, "#Stayhome playing lol - analyzing players' activity and social bonds in league of legends during covid-19 lockdowns," in *The 16th International Conference on the Foundations of Digital Games (FDG) 2021*, 2021, pp. 1–12.

[21] D. Khajeheian and S. Kolli, "Digital games get viral on social media: A social network analysis of pokémon go on twitter," *International Journal of Web Based Communities*, vol. 16, no. 3, pp. 262–278, 2020.

[22] *Twitter api*. [Online]. Available: https://developer.twitter.com/en/docs/twitter-api.

[23] R Core Team, *R: A language and environment for statistical computing*, R Foundation for Statistical Computing, Vienna, Austria, 2020. [Online]. Available: https://www.R-project.org/.

[24] *Gnu gpl v2 license*. [Online]. Available: https://www.gnu.org/licenses/old-licenses/gpl-2.0.en.html.

[25] *What is R Analytics?* [Online]. Available: https://www.tibco.com/reference-center/what-is-r-analytics.

[26] G. Van Rossum and F. L. Drake, *Python 3 Reference Manual*. Scotts Valley, CA: CreateSpace, 2009, ISBN: 1441412697.

[27] *Reasons Why Using R for Data Science Projects is Your Best Bet*. [Online]. Available: https://hackr.io/blog/r-for-data-science.

[28] J. Roesslein, "Tweepy: Twitter for python!" *URL: https://github.com/tweepy/tweepy*, 2020.

[29] *Common format and mime type for comma-separated values (csv) files*. [Online]. Available: https://datatracker.ietf.org/doc/html/rfc4180.

[30] G. Csardi and T. Nepusz, "The igraph software package for complex network research," *InterJournal*, vol. Complex Systems, p. 1695, 2006. [Online]. Available: https://igraph.org.

[31] *Covid-19 impact on the gaming industry worldwide*, 2021. [Online]. Available: https://www.statista.com/topics/8016/covid-19-impact-on-the-gaming-industry-worldwide/.

[32] J. Weustink, *80 percent of gen z and millennial consumers play games*, 2021. [Online]. Available: https://newzoo.com/insights/articles/consumer-data-gen-z-millennials-baby-boomer-gen-x-engagement-games-esports-metaverse/.

[33] A. Lenhart, "Chapter 4: Social media and friendships," *Pew Research Center: Internet, Science & Tech*, vol. 6, 2015.

[34] *Lifetime concurrent users on steam*. [Online]. Available: https://steamdb.info/app/753/graphs/.

[35] D. Şener, T. Yalçın, and O. Gulseven, "The impact of covid-19 on the video game industry," *Available at SSRN 3766147*, 2021.