IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 6, June 2023

DOI: 10.17148/IARJSET.2023.10686

Examining the Potential and Advantages of Cloud Gaming

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Abstract: Gamers may now get high-quality gaming experiences anytime and anywhere thanks to cloud gaming. In cloud gaming, complex game software is operated on powerful servers in data centres, rendered game scenes are broadcast to players in real-time over the Internet, and players utilise lightweight software that is run on a variety of devices to interact with the games. Since the late 2000s, high-speed networks and cloud computing have proliferated, attracting a lot of attention from both the academic and business communities. In this post, we review the most recent studies on cloud gaming from a variety of angles, including platforms, optimisation methods, and for-profit cloud gaming services. The reader will learn about the history of cloud gaming research and the most recent advancements in this field.

A fascinating new technology that has gained popularity recently and has the potential to completely transform the gaming business is cloud gaming. This study intends to investigate the practicality and advantages of cloud gaming and assess any potential effects it might have on the gaming market.

The research paper starts out by giving a general review of cloud gaming and its underlying technologies. The benefits of cloud gaming are then discussed, including their accessibility, affordability, and scalability. The study looks at the difficulties that cloud gaming encounters, including latency, bandwidth, and data security issues.

The study examines the business models of significant cloud gaming platforms including Google Stadia, Microsoft Cloud, and NVIDIA GeForce Now in order to comprehend the state of cloud gaming today. The research paper also looks at how cloud gaming will affect the gaming market, including how it might change it and provide game producers new business prospects.

The future of cloud gaming and its prospective effects on the gaming industry are discussed in the paper's conclusion. It offers information about the difficulties that must be overcome in order to guarantee the universal acceptance of cloud gaming and the possible advantages for both players and game producers.

Keywords: Cloud Gaming, Gaming Industry, Technology, Scalability, Business Models, Latency, Bandwidth, Data Security, Future.

INTRODUCTION:

The gaming industry has grown significantly over the last few decades, and by 2024, it is predicted that the worldwide gaming market would be worth $218.7 billion (Statista, 2021). The gaming business still has to overcome a number of obstacles, such as the need for expensive gaming hardware, the scarcity of some games, and the inaccessibility of certain games to players using less expensive hardware. Many of these issues can be resolved via cloud gaming, which gives players access to top-notch games without the expense of high-end hardware.

With the help of a technique called cloud gaming, consumers may play games without expensive gear by streaming them directly from distant servers to their smartphones. Cloud gaming makes gaming more accessible than ever before because players may access games from any location and on any device. Additionally, because players do not need to buy pricey hardware or game licences, cloud gaming is a more affordable option than traditional gaming.

In this study, we examine the practicality, advantages, and prospective effects of cloud gaming on the gaming industry. We'll look at the technological underpinnings of cloud gaming, its benefits and drawbacks, and the operating systems of the main cloud gaming platforms. We'll also talk about how cloud gaming might affect the game business and give some predictions for its future.

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A new method of delivering computer games to users is known as "cloud gaming," in which computationally challenging games are run on powerful cloud servers, rendered game scenes are streamed over the Internet to players using thin clients on a variety of devices, and control events from input devices are sent back to cloud servers for interaction. Using cloud gaming services is shown in Figure 1. A cloud gaming platform is housed on cloud servers that are located in one or more data centres. The computer game programmes that the cloud gaming platform runs may be loosely divided into two main categories: (i) game logic, which is in charge of translating player input into in-game interactions, and (ii) scene renderer, which creates game scenes in real-time. The command interpreter gives the gamer instructions, while the video capturer records the gaming scenes into videos. which a video encoder then compresses. The cloud gaming platform includes the command interpreter, video capturer, and video encoder. The cloud gaming platform, as depicted in this image, distributes video frames to thin clients that players use to play games and gets user input from them. It is a thin client because it only needs two simple parts: a command receiver that connects to gaming controllers such joysticks, keyboards, and mice, and a video decoder that can be implemented using cheap, widely available decoder chips. Supporting real-time computer games is quite difficult since communications between the cloud game platform and thin clients take place over the best-effort Internet.

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TECHNOLOGICAL FOUNDATIONS:

Cloud gaming uses the architecture of cloud computing to give players access to top-notch games without the need for pricey gear. Players can stream games directly from distant servers that are outfitted with strong hardware and graphics processing units (GPUs) using cloud gaming. While the user's device shows the game stream, the servers manage the game's processing and rendering.

Utilising low-latency networks, which are crucial for minimising the lag between player input and game response, is one of the key technologies underlying cloud gaming. The amount of time that passes between user input and the game's response is known as latency, and it is crucial in cloud gaming. Input lag caused by high latency can have a big impact on the game experience. To enable responsive and lag-free gameplay, cloud gaming platforms rely on low-latency networks.

Video encoding and streaming are two more crucial technologies used in cloud gaming. The server must encode the game stream into a format that can be transmitted over the internet in order to stream games. Cloud gaming platforms often use specialised hardware, such GPUs, to expedite the encoding process because it calls for a lot of processing power. The game stream is then delivered over internet to the user's device, where it is decoded and shown.

In order to give players a high-quality gaming experience without the need for expensive hardware, cloud gaming depends on a number of critical technologies. The following are a few of the key technologies that make cloud gaming possible.

1. Infrastructure for Cloud Computing:

Cloud gaming relies on distant servers that are outfitted with strong CPUs and GPUs to process and render the game. These servers are housed in data centres that have high-speed networks connecting them to the internet. To provide low-latency and high-availability, cloud gaming providers often deploy a distributed cloud computing architecture.

2. Networks with little delay

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For cloud gaming, low-latency networks are essential since they reduce the time it takes between user input and game response. To guarantee low-latency network connections, cloud gaming services often leverage content delivery networks (CDNs) and edge computing. Users may obtain game content from the location that is nearest to them thanks to CDNs, which store game data across numerous locations and reduce latency. Further reducing latency, edge computing brings game computation closer to the user.

3. Encoding and streaming video:

The server must encode the game stream into a format that can be transmitted over the internet in order to stream games. Cloud gaming platforms often use specialised hardware, such GPUs, to expedite the encoding process because it calls for a lot of processing power. The game stream is then delivered over the internet to the user's device, where it is decoded and rendered for display.

4. Input Management:

Cloud gaming platforms must control user inputs and make sure that they are accurately and swiftly transferred to the server. Cloud gaming systems use methods like predictive input to do this, which allows the server to anticipate the user's subsequent input based on their past inputs, lowering latency and enhancing the game experience.

5. Virtualization:

The technology that allows cloud gaming providers to distribute computing resources across numerous players is virtualization. Cloud gaming providers can dynamically assign resources by virtualizing the server hardware, guaranteeing that each user receives the necessary processing power and reducing resource waste. Experience quality (QoE)

quality of Experience (QoE)

In order to increase customer satisfaction in cloud gaming, Asif Ali Laghari [22] et al. intend to improve Quality of Experience (QoE) by offering us Quality of Service (QoS) in accordance with the Service Level Agreement (SLA). QoS requires the support of apps, models, and protocols in order for users to have universal access to cloud gaming services. The communication quality for cloud gaming should be improved by meeting a number of criteria, including minimal latency variance, low error rate, high bandwidth, and low packet loss. Two different approaches—one network-based and the other based on video streaming—were examined for cloud gaming with all of these considerations in mind. In video streaming, the video is compressed without compromising the video's quality, and the service quality is adjusted for bandwidth and latency. The network-based solution, which offered greater video quality and more responsiveness, was also discovered to be effective. Gaming Anywhere, a cloud gaming platform, was utilised to examine the network-based strategy. Finally, it was determined that elements like bitrate, framerate, and packet loss have a significant impact on the user's quality of experience (QoE) and that more work needs to be done to enhance cloud gaming.

OBSERVATIONS

In this essay, we have reviewed and annotated materials pertaining to earlier research in this area. The papers discussed the broad idea of cloud gaming and offered practical solutions to the problems that are regularly encountered. Designing frameworks like Edge Games [18] have improved the cloud gaming experience by reducing latency delay and bandwidth consumption. ISSN (Online) 2394-2320 International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)Vol 7, Issue 9, September 2020 26. Even while this sounds excellent, designs and frameworks can still be strengthened to produce a much better outcome. The major elements that still require attention or development are listed below.

1. Lag

All data processing and visual rendering occurs on the local system when playing on a PC or console. As a result, there is a tiny lag or delay. If the player is located distant from the central cloud when using a cloud gaming platform, there may be some lag or delay. The gamers who are close to the cloud server where all the processing is being done benefit unfairly from this delay.

2. Edge Computing

Cloud gaming data is processed in a single, central cloud. Application processes can be distributed at the network's edge, as close to the user as possible, with the aid of edge computing. Edge computing has made it possible for technologies

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like mobile computing [28] and the Internet of Things (IoT) [29] to exist. Businesses anticipate that by 2025, an enormous 75% of company data will be processed at the edge.

3. High-end network requirements

Low-end smartphones can now play graphically demanding games thanks to cloud gaming. However, because everything is relayed over the internet, a strong internet connection is needed. In addition to having a strong internet connection, it also needs a powerful computer with 4 GB of system memory, Windows 7 (64-bit), a dual-core X86 processor running at 2.0 GHz, and a GPU that supports DirectX 11.

4. FPS games

When done right, playing games in the cloud may be a flawless experience that is nearly identical to playing games that are installed locally. Fast-paced first-person shooter games are still vulnerable to network issues, and even a slight delay can cause the player to lose focus from the intense gaming experience.

5. Other network Conditions

While frameworks and methods have been developed to address the difficulties provided by bandwidth and latency during cloud gaming, variables like packet loss and jitter continue to have a significant impact on cloud gaming [30] and have not yet been fully investigated.

6. Database for Online games:

Smaller games can use a single relational database server, but large games with millions of players like PUBG, Fortnite and others can't since they can't be changed dynamically, which is why there is another form of database. [18] Scalability and schema changes provide significant difficulties for high-performance gaming, which is why NoSQL databases are being used.

which are taken into account and which take a more lenient view on databases used for online gaming:

1. Scaling: They can be scaled horizontally and do so with no downtime. Because NoSQL databases take some time to reflect all the changes made, performance compromises might occasionally occur during scaling. Eg : FireBase Firestore.
2. Schema changes: Relational databases have a very tough time changing dynamically while being used. It is simple to make all the required modifications with NoSQL databases.
3. Administration: Identity access management, or IAM, makes it simple to provide credentials to users at different levels in order to maintain and manage multiple services.

CONCLUSION:

Over the years, there have been many ups and downs in the gaming industry. The cloud, however, has revolutionised gaming in the modern day. It has the capacity to change and provide the general public a totally different viewpoint. Because users can compete against actual gamers and maintain track of their success globally, it is far superior to offline games. In the case of offline games, the developers are also relieved of the duty to produce fresh updates and resell them. Any downtime can be used for over-the-air upgrades. You may add new maps without having to make significant modifications. Playing online games makes it simple to buy in-app items. [93] There is so much to anticipate in terms of gaming online Research is being done on quick-response approaches as well as simple deployment techniques. For developing such complicated systems, the microservices architecture has shown to be highly effective and lightweight. Additionally, it can be optimised to minimise errors and response failures. E-sports have gained popularity among players all around the world as a result of this industry's optimistic growth over the previous ten years. The demand for games may increase as a result, and more responsive designs may enable greater financial gain.

The advent of cloud gaming has revolutionised how consumers play video games. Without the need for pricey hardware, gamers can get top-notch gaming experiences via cloud gaming. For a seamless gaming experience, the technology combines cloud computing infrastructure, low-latency networks, video encoding and streaming, input management, and virtualization.

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The flexibility to play games on a variety of platforms, simple access to new titles, and lower hardware expenses are just a few benefits of cloud gaming. But it also has some drawbacks, like the requirement for fast internet connections, the possibility of lag and latency, and worries about data security and privacy. Despite these difficulties, the popularity of cloud gaming has grown recently, with large companies like Google, Microsoft, and Amazon investing in the technology.

Cloud gaming should become even more available and immersive as cloud computing and network technologies develop.

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