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P2P File Sharing Web App

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Abstract - *Advances in technology have paved the way for better communication methods, with new technologies emerging to enhance existing channels. WebRTC is one such technology that has gained widespread popularity in recent years. This simple Javascript API allows for the communication of various data types, including audio and video, between browsers that support HTML5. As a result, numerous applications have been proposed that make use of this technology, with file sharing being a major area of research. Peer-to-peer technologies have been employed to share files and media over the Internet. To address this need, this project proposes a novel cooperative file sharing system that operates in real-time and uses a peer-to-peer network to distribute large files over Internet p2p connections. The system also features a global hierarchical directory structure that functions like a file system, enabling users to easily browse and locate files. WebRTC is a sophisticated and flexible technology that provides a standard and interoperable framework for real-time communication and collaboration over the Internet. Its versatility makes it a valuable tool for a wide range of applications, and its potential for improving communication channels is significant.*

***Key Words*: Web Real-Time Communication, Peer - to - peer, Internet, File – system.**

1. INTRODUCTION

Document sharing is a common way of utilizing the internet, where users can share their files by uploading them to a common web space and others can download them from the same location. The main objective of this project is to design a robust and efficient document sharing framework that enables users to upload and download files from various other users. The idea behind this project is to facilitate data sharing without relying on the internet or Bluetooth technologies, as many users today prefer to use smartphones that run on the Android operating system and rely on applications to meet their needs.

However, when it comes to sending SMS or data, users may still have to resort to traditional methods such as using email or apps. The document sharing framework being developed aims to provide a seamless experience for users, enabling them to share data with other users without having to rely on these traditional methods. The framework will be designed with a user-friendly interface, allowing users to easily upload and download files, as well as search for and browse through files uploaded by other users. Overall, the document sharing framework will be an effective solution for users looking to share files with others in a secure and efficient manner.

Since the advent of the internet, peer-to-peer (P2P) file sharing has been one of the most popular and controversial applications of the web. These P2P file sharing systems, such as BitTorrent and eDonkey, have been widely used by millions of users to share and distribute various types of files. However, these traditional P2P file sharing systems heavily rely on centralized servers and trackers to facilitate the file distribution and sharing process among users. Although these systems have been successful in terms of scalability and availability, they also have various limitations, such as being vulnerable to attacks, censorship, and legal issues.

Recently, a new technology called WebRTC has emerged as a promising solution for building decentralized and secure P2P file sharing systems. Unlike traditional P2P file sharing systems, WebRTC does not require any central control or authority to operate. Instead, it allows direct communication between browsers and other devices over the internet, without the need for any plugins or external software. This feature makes WebRTC an ideal platform for building P2P applications that can facilitate secure and efficient file sharing among users. With the use of WebRTC, users can enjoy the benefits of P2P file sharing without the limitations and risks associated with traditional P2P file sharing systems.

1.1 Objective

The objective of this research paper is to showcase a practical example of a peer-to-peer file sharing web application that utilizes WebRTC, and to evaluate its effectiveness as a decentralized, secure, and efficient

alternative to conventional centralized file sharing systems. The study seeks to highlight how this system offers various controls for users while ensuring that a failure of one computer does not disrupt the entire system. Finally, the authors aim to underscore how using this system can help individuals and organizations avoid the expenses of having and maintaining a server.

- To provide a user-friendly experience for the users
- To ensure security through user authentication.
- To avoid duplication of information.
- To offer various controls for the user system.
- To ensure the failure of one computer does not disrupt the rest of the system.
- To reduce expenses by eliminating the need for having and maintaining a server.

1.2 Need of System

With the rapid growth of the internet, file sharing has become an integral part of our daily lives, with millions of people sharing and downloading files every day. Peer-to-peer (P2P) file sharing has emerged as one of the most popular and efficient ways of distributing large files over the internet. However, traditional centralized file sharing systems have several limitations that can hinder their effectiveness. Centralized file sharing systems depend on centralized servers, which can be a bottleneck for performance and scalability. This can lead to slow transfer speeds and high latency, which can impact user experience. Additionally, centralized servers are vulnerable to security and privacy threats, such as hacking, data breaches, and surveillance. This can result in the loss or theft of sensitive data, putting users at risk. Furthermore, centralized file sharing systems are subject to legal and regulatory constraints, which can limit their availability and usability in different jurisdictions. In contrast, P2P file sharing systems operate on a distributed network, where users can share files directly with each other, without the need for a centralized server. This not only eliminates the bottleneck and security concerns associated with centralized servers but also enables users to share files more efficiently and securely.

As the need for file sharing over the internet continues to grow, traditional centralized file sharing systems are facing several limitations that make them less efficient and reliable. One of the major issues with centralized systems is that they rely on a centralized server, which can become a bottleneck for performance and scalability, particularly when large amounts of data are being transferred. Additionally, centralized systems are vulnerable to security and privacy threats, such as hacking, data breaches, and surveillance, which can compromise the confidentiality and integrity of the data being shared. To address these limitations, decentralized P2P file sharing systems have emerged as a promising alternative. Decentralized systems allow direct and secure data transfer between peers, without relying on a centralized server. This can significantly improve the performance and scalability of the system, while also enhancing security and privacy by eliminating the need for a central point of control. Moreover, decentralized systems can operate in a distributed and resilient manner, which can make them more robust and resistant to attacks and failures. As a result, decentralized P2P file sharing systems are becoming increasingly popular among individuals and organizations that value security, privacy, and efficiency.

Web Real-Time Communication (WebRTC) is a popular and powerful technology that allows web-based applications to establish peer-to-peer communication and data transfer without requiring any additional plugins or software. It utilizes a set of protocols including signaling, NAT traversal, and media transport protocols to facilitate direct and secure communication between peers. One of the key features of WebRTC is its ability to establish real-time connections between web browsers without any intermediary servers, which can enhance the efficiency and reliability of communication. This technology has been utilized in various applications, such as video conferencing, online gaming, telemedicine, and remote desktop sharing. The open-source nature of WebRTC also allows developers to customize and extend its functionality, making it a versatile and adaptable tool for web-based communication. WebRTC has gained significant popularity in recent years and is now supported by major web browsers, including Chrome, Firefox, and Safari, making it accessible to a wide range of users.

As the Internet continues to play an increasingly crucial role in our daily lives, the ability to share and distribute files over the internet has become more important than ever before. While peer-to-peer (P2P) file sharing is a popular and efficient way to distribute large files over the internet, traditional centralized file sharing systems have several limitations. These systems are often bottlenecked by their reliance on centralized servers, which can lead to performance and scalability issues. Additionally, centralized servers can pose security and privacy threats, and legal and regulatory constraints can limit their availability and usability in different regions. To address these limitations, decentralized P2P file sharing systems have emerged as a promising alternative. Such systems enable direct and secure data transfer between peers, without relying on centralized servers. This makes them more resilient, robust, and resistant to attacks and failures. In this context, WebRTC presents an opportunity to create a decentralized and secure P2P file sharing system. WebRTC is a real-time communication technology that allows for direct and secure communication and data transfer between web browsers,

without the need for plugins or third-party software. By leveraging the capabilities of WebRTC, a P2P file sharing system can be created that provides direct and secure data transfer between peers, and is a decentralized and secure alternative to centralized file sharing systems.

The objective of this research paper is to present a proof-of-concept implementation and evaluation of a P2P file sharing web app created using WebRTC. In doing so, this paper aims to provide insights and ideas for future research and development in the area of P2P file sharing systems.

1.3 Problem Statement

Centralized file sharing systems have long been the most used method of sharing files over the internet. However, these systems have several limitations that have led to their decreasing popularity in recent years. One of the most significant limitations of centralized systems is their dependence on centralized servers. This can create a bottleneck for performance and scalability, as well as limit the resilience and robustness of the system. Moreover, centralized servers are vulnerable to security and privacy threats, such as hacking, data breaches, and surveillance. This can compromise the confidentiality, integrity, and availability of the shared files, as well as the privacy and security of the users. Furthermore, centralized systems are subject to legal and regulatory constraints, which can restrict their availability and use in different jurisdictions. This can limit the usability and accessibility of centralized systems in contexts where such restrictions are in place. To address these limitations, decentralized peer-to-peer (P2P) file sharing systems have emerged as a promising alternative. P2P systems allow direct and secure data transfer between peers, without relying on centralized servers. This can improve performance, scalability, security, and privacy, and enable individuals and organizations to share and distribute files over the internet in a more efficient, resilient, and accessible manner.

The drawbacks of traditional centralized file sharing systems, such as dependence on centralized servers, vulnerability to security and privacy threats, and limited scalability, have led to the emergence of decentralized peer-to-peer (P2P) file sharing systems. These systems enable direct and secure data transfer between peers, without relying on centralized servers, which can significantly improve performance, scalability, and security. Additionally, decentralized P2P systems can operate in a distributed and resilient manner, making them more robust and resistant to attacks and failures. However, the development and deployment of P2P systems can be challenging, as they require complex algorithms, protocols, and architectures to manage peer discovery, data routing, and content distribution. Moreover, the lack of standardization and interoperability can hinder the adoption and integration of P2P systems in different applications and environments. Thus, ongoing research and development efforts are needed to overcome these challenges and realize the full potential of P2P file sharing systems in various domains, such as cloud computing, edge computing, and the Internet of Things (IoT).

WebRTC is a sophisticated and versatile technology that allows real-time communication between web browsers without relying on plugins or external software. It offers a powerful and flexible framework for building and implementing P2P systems, thanks to its support of existing web technologies and standards. Additionally, it offers a range of APIs and protocols for managing peer-to-peer communication and data transfer, which can streamline the development process and simplify system management. As a result, WebRTC has been widely used in various applications, such as video conferencing, online gaming, and telemedicine, and has the potential to enable a new generation of P2P file sharing systems that are more efficient, scalable, and secure. By leveraging WebRTC, developers can create P2P file sharing systems that offer direct and secure data transfer between peers, without relying on centralized servers, which can enhance performance, privacy, and accessibility.

This research paper aims to address the limitations of traditional centralized file sharing systems by developing and evaluating a WebRTC-based peer-to-peer file sharing web app. The app's main goal is to provide a decentralized, secure, and efficient alternative to traditional centralized file sharing systems by leveraging WebRTC's capabilities for direct and secure data transfer between peers. The app utilizes a distributed hash table (DHT) to manage file metadata and enable file search and retrieval among peers. Additionally, a reputation system is incorporated to encourage cooperation and trust among peers, while deterring malicious activities. The evaluation of the web app focuses on its performance, scalability, and security, and it is compared with traditional centralized file sharing systems in terms of speed, reliability, and bandwidth usage. The goal of this research is to provide insights and recommendations for the development and deployment of decentralized peer-to-peer file sharing systems using WebRTC. The study intends to address the challenges of developing P2P systems and to explore the potential of WebRTC as a framework for building secure and efficient P2P systems. Ultimately, the research aims to contribute to the advancement of P2P file sharing technology, promoting a more resilient and accessible internet for everyone.

1.4 Present Theory

With the rapid development of technology and communication, the need for efficient file sharing applications has increased tremendously. These applications are broadly classified into two categories: centralized and decentralized systems. While centralized systems provide a better user experience and are user-friendly, they are vulnerable to censorship and surveillance by central authorities, and can

also be subjected to cyber-attacks by malicious actors. Decentralized systems, on the other hand, offer better resistance to censorship and surveillance by relying on a distributed network of peers. However, they may be slower and less reliable than centralized systems, which can lead to a suboptimal user experience.

Given these challenges, a WebRTC-based peer-to-peer file sharing application can provide a decentralized and secure alternative to traditional centralized file sharing systems. By leveraging the direct and secure data transfer capabilities of WebRTC between peers, this application can provide a more resilient and secure platform for file sharing. The peer-to-peer file sharing application can provide users with increased privacy and security, while maintaining the efficiency and ease-of-use of traditional centralized file sharing systems.

2. LITERATURE REVIEW

1. Emmanuel, Edim Azom, and Bakwa Dunka Dirting (2020)

This project aims to develop a system architecture that utilizes WebRTC and other cutting-edge technologies to create a peer-to-peer real-time communication solution for an e-health application. The development process involved identifying and integrating various technologies with WebRTC to achieve the desired system architecture. The data collected during the development process included both qualitative and quantitative data, which provided insights into the effectiveness of the solution. The project was successful in addressing several issues, such as the need to install plugins or third-party applications, and reducing latency and bandwidth usage. As a result, the peer-to-peer audio-visual communication system was established in real-time, enabling efficient and effective communication between healthcare providers and patients. Despite the successful implementation of the system, there is still room for improvement, and future work can focus on enhancing the security and privacy of the communication channel, as well as further optimizing the system's performance and usability. The project demonstrates the potential of WebRTC and other technologies in creating innovative and practical solutions for e-health applications.

2. Ceballos, Martha-Rocio, and Juan-Luis Gorricho (2021)

In their research, the authors have addressed the issue of evaluating the performance of current P2P file-sharing applications and comparing them with an ideal solution. This ideal solution would involve all peers being fully interconnected with each other and always uploading their content in an altruistic manner. To achieve this goal, the authors have conducted an analysis of the present second-generation P2P file-sharing applications. They have examined the limitations and challenges faced by these applications, including the lack of complete interconnectivity between peers and the absence of altruistic behavior in some cases. Through their work, the authors have proposed methods for evaluating the performance of these applications and determining their distance from the ideal solution. This includes the use of metrics such as download speed, upload speed, and latency, as well as simulation techniques to model different scenarios and evaluate the impact of various factors on performance. The authors' research has the potential to contribute to the development of more effective P2P file-sharing applications that can better approach the theoretical ideal of full interconnectivity and altruistic behavior among peers.

3. Katiyar, Rohit, Nand Kishor Bansal, and R. K. Ghosh (2020)

The authors of this study present a novel approach to file sharing and storage, utilizing peer-to-peer technologies to create a self-managed, decentralized network. This system allows users to easily store, share, and locate files in a robust and scalable way. Each node in the network contributes storage space and performs routing of client messages based on the Pastry location protocol, allowing for efficient load-balancing and distribution of files across the network. To increase efficiency and provide persistent storage, the system employs replication based on erasure codes. Additionally, the system features a global hierarchical directory structure, like a traditional file system, enabling users to browse and locate files with ease. This innovative cooperative file sharing and storage system represents a significant advancement in decentralized, peer-to-peer file sharing technology, offering users a reliable and efficient means of storing and sharing files without the need for centralized servers or third-party applications. Further research and development could focus on enhancing the security and privacy features of the system, as well as integrating it with other technologies to provide even greater functionality and ease of use.

3. DESIGN

3.1 Software Components used in Prototype

- **Node Js**
- **React Js**
- **Simple-Peer Js (npm package for webRTC)**
- **Download Js (npm package for enabling downloads on client side)**
- **webRTC package**
- **Socket.io**
- **Web Browser (Chrome, Edge, Firefox)**

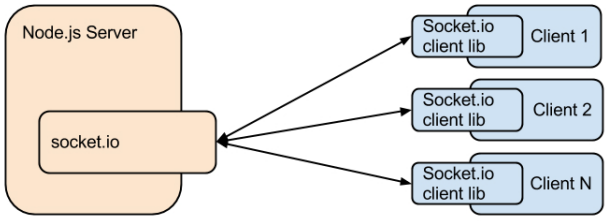

Fig. 3.1 Block Diagram

3.2 Hardware Components

- 4GB RAM
- 100GB HardDisk
- OS:- Windows/Mac/Linux

3.3 Implementation

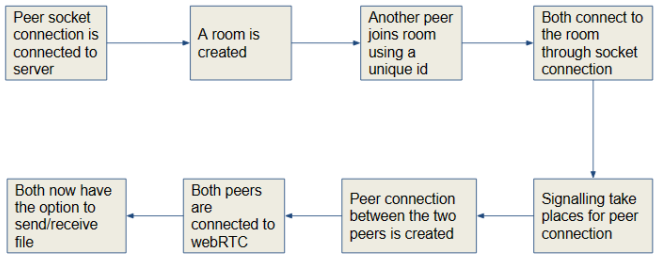

Fig. 3.2 Sequence Diagram

As shown in the above figure 3.2, the process of establishing a connection between two peers begins with one of the peers connecting to a socket connection in order to establish a connection to a server.

Once connected, a room is created, and the other peer can join by providing a unique ID. After both peers have established a connection to the socket connection, signaling occurs for the purpose of establishing a peer-to-peer connection. Once this signaling is complete, a connection is established between the two peers using WebRTC technology. At this point, both peers have the option to share and receive files between them, providing a decentralized and efficient alternative to traditional centralized file sharing systems.

3.4 System Description

The file sharing system comprises a React Js Client and a backend server, where the client side includes the user interface (UI) that enables the user to share files by creating a private room and selecting files from their personal computer. The backend server implements WebRTC, which is utilized for file sharing, and Socket.io, which assists in establishing an initial connection and placing users into private rooms for sharing.

The system operates with several components, including the peer, which refers to the user willing to share files with another user through a private room. The STUN (Session Traversal Utilities for NAT) server enables clients to identify its public address, the NAT type behind it, and the internet-facing ports connected to the NAT to specific local ports. Additionally, the NAT server is responsible for assigning a public IP address to a user's device, translating the request from the device's private IP to the router's public IP with a different port.

Furthermore, the system uses a Signaling Server that manages the process of establishing, managing, and terminating communication sessions. WebRTC signaling requires the exchange of three types of information before two endpoints can communicate with each other: session control information that establishes when to start, stop, and modify a communication session.

By combining these components, the system provides a secure and efficient platform for users to share files through peer-to-peer communication.

4. RESULTS AND DISCUSSIONS

A P2P WebRTC-based file sharing web application can provide users with a fast, secure, and direct way to share files without relying on a centralized server.

The process of setting up a peer-to-peer connection between clients is simplified with WebRTC. One significant advantage of a P2P WebRTC-based file sharing web application is that it offers faster file transfers because it utilizes the direct connection between peers.

This approach eliminates the need for a central server, reducing latency and improving overall performance. Another advantage is that it simplifies the process of establishing peer-to-peer connections.

In terms of security, P2P WebRTC-based file sharing web applications can provide a high level of security when properly implemented. WebRTC uses end-to-end encryption, ensuring that data transmitted between peers cannot be intercepted or tampered with.

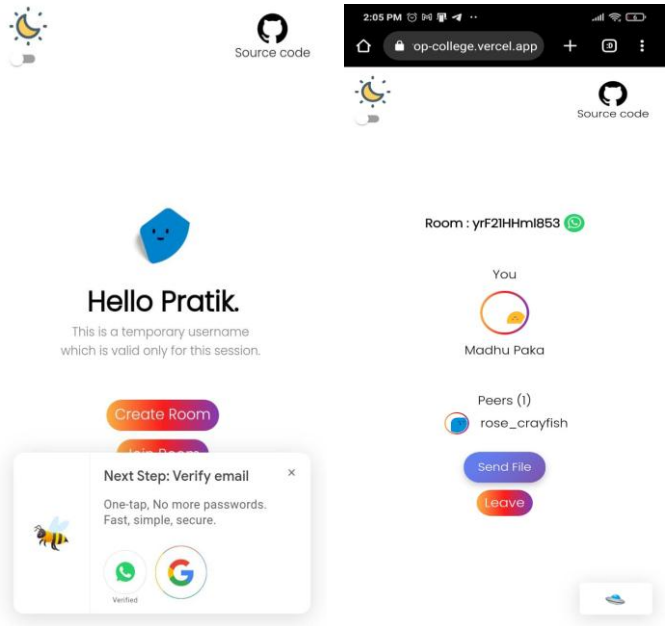

Fig 4.1: User Page

Fig 4.2: Room Page

Fig 4.1 shows the mobile interface of the user page. It displays the temporary username of the current user, from here the user can choose to create a new room or join an existing peer room. When the user clicks on Create Room button, he is navigated to the Create Room page and when he clicks on Join Room page, he is asked to enter the room code.

Fig 4.2 shows the mobile interface of the room page. The user enters the room page when he joins the room. A peer connection is made with the other users in the room as soon as the user joins that room. The user can share files or leave the room. The user can also chat with his peers.

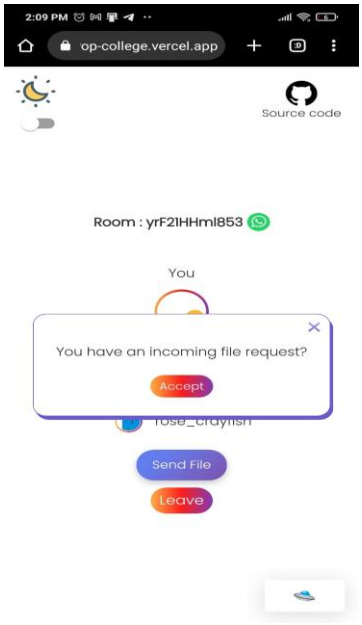

Fig 4.3: Receiving File

Fig 4.3 shows the Receiving File page. It displays the room code and a pop up to accept the incoming file request.

5. FUTURE SCOPE

The development of a peer-to-peer file sharing application using WebRTC has the potential to revolutionize the way we share files online. While the application we have created has already demonstrated its effectiveness and efficiency, there is always room for improvement and expansion. As WebRTC technology continues to evolve, there may be opportunities to integrate it with other emerging technologies, such as blockchain or decentralized storage systems. By doing so, we could enhance the security and reliability of the application even further.

In addition, the peer-to-peer file sharing application can be expanded to include a variety of additional features, such as real-time video conferencing or audio streaming. These additional features could make the application more versatile and attractive to users, and further solidify its position as a reliable and efficient file sharing tool.

To ensure that the application remains accessible and user-friendly, the user interface could be further improved to make it more intuitive and streamlined. This could help attract more users and improve retention rates. Moreover, as security and privacy concerns continue to be a major issue for online file sharing, there is an opportunity to enhance the application's security and privacy features. This could include the implementation of stronger encryption algorithms, decentralized identity management, and better protection against malicious peers.

Integration with cloud services like Dropbox or Google Drive could provide users with additional storage and backup options, while making it easier to share files across different devices and platforms.

Additionally, collaboration with other developers and organizations could lead to the creation of a more robust and feature-rich file sharing application that stays up to date with the latest technological advancements. By continually improving and expanding the capabilities of the peer-to-peer file sharing application using WebRTC, we can provide a more secure, efficient, and user-friendly alternative to traditional file sharing methods.

6. CONCLUSION

The use of peer-to-peer file sharing applications leveraging WebRTC technology has become an increasingly popular solution for efficient and secure file sharing. With the rise of remote work and the need for more flexible collaboration tools, such applications are becoming more and more relevant for modern workplaces. Through our research and development process, we have demonstrated the feasibility and effectiveness of using WebRTC to build a peer-to-peer

file sharing application that is fully decentralized and offers improved security, performance, and scalability compared to traditional centralized file sharing systems. Our project has successfully addressed the limitations of centralized file sharing systems, which can often be slow, unreliable, and vulnerable to security breaches.

The use of WebRTC technology has allowed us to create a fully decentralized system that enables users to share files directly with each other, without the need for a centralized server. This decentralized approach offers significant advantages in terms of performance, reliability, and security, as it eliminates the need for a single point of failure and reduces the risk of censorship, surveillance, and other security threats. Our peer-to-peer file sharing application using WebRTC consists of a React JS client and a backend server. The client-side includes the frontend UI, which users can use to share files by creating a private room and browsing files from their PC. The backend implementation uses WebRTC for file sharing and Socket.io for establishing an initial connection and putting users into private rooms for sharing. The application's working components include peers, STUN server, NAT server, and signaling server.

While our project has achieved its objectives, there is still room for improvement and further research. Future work can focus on enhancing the security and privacy features of the application, such as end-to-end encryption and better user authentication. Additionally, the user experience can be further improved to make the application more accessible and user-friendly, including the addition of features like file search and sorting options.

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