**Decentralized Video Conferencing Web-application**

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***Abstract*- *In today's interconnected world, video conferencing is crucial for communication, but traditional systems relying on centralized servers are plagued by privacy, security, and single-point failure issues. This project presents a decentralized video conferencing web application that addresses these challenges by leveraging peer-to-peer (P2P) communication and Web Real-Time Communication (WebRTC) technology. The application enables real-time audio, video, and data sharing directly between browsers, reducing latency and enhancing user experience. A key feature is the integration of smart contracts, which automate processes, eliminate third-party intermediaries, and ensure secure, transparent interactions. Developed using React.js and Next.js, the application boasts a robust framework for interactive user interfaces and improved performance. By embracing decentralization, this platform sets a new standard for secure, efficient digital communication, protecting user data and privacy.***

# I.Introduction

In today's interconnected world, video conferencing has become essential for communication across various domains, from personal interactions to professional meetings.

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However, traditional video conferencing systems, which rely on centralized servers, pose significant challenges such as privacy concerns, security vulnerabilities, and potential single points of failure. To overcome these issues, a decentralized video conferencing web application offers a promising solution, leveraging advanced technologies to ensure secure, private, and efficient communication.

This project centers on the concept of peer-to-peer (P2P) communication, eliminating the need for central servers by establishing direct connections between users. By utilizing Web Real- Time Communication (WebRTC), the application enables real-time audio, video, and data sharing directly between browsers. WebRTC's capabilities significantly reduce latency and enhance the overall user experience, making it an ideal choice for this decentralized approach.

A key feature of the application is the use of smart contracts, which are self-executing

contracts with the terms directly written into code. Smart contracts automate and safeguard various processes within the application, eliminating the reliance on third-party intermediaries and enhancing security by ensuring that all interactions are securely and transparently recorded.

The application is developed using cutting-edge web technologies, including React.js and Next.js. React.js offers a robust framework for building interactive and dynamic user interfaces, while Next.js enhances the performance and scalability of the application through server-side rendering and static site generation. These technologies together ensure a seamless and responsive user experience.

By embracing decentralization, this video conferencing web application provides a secure and private platform for users to communicate. It addresses the limitations of traditionalsystems, ensuring that user data remains protected and interactions are free from centralized control. This innovative approach not only enhances privacy and security but also sets a new benchmark for future decentralized applications, paving the way for more secure and efficient digital communication solutions.

# II.Literature Review

### I.I DecVi: Adaptive Video Conferencing on Open Peer-to-Peer Networks(2023)

**Authors :** Jingren Wei, Shaileshh Bojja Venkatakrishnan.

**Study Overview:** Video conferencing's shift to decentralized, blockchain-incentivized peer-to-peer networks counters centralization issues like data center proximity bias and privacy concerns. DecVi proposes a decentralized multicast tree protocol, adapting through and exploration-exploitation framework akin to multi-armed bandit problems. It achieves high reliability and flexibility without requiring global server coordination.

**Drawbacks:** DecVi, a decentralized video conferencing system, faces challenges such as implementation complexity, scalability issues, latency variability, security vulnerabilities, and bandwidth constraints, which can affect user experience and network performance.

### I.II A REVIEW OF MYFRAMES –VIDEO CONFERENCING WEB APPLICATION USING WEBRTC(2021)

**Authors :** Ganesh Vishnu Parbat, Altaz Altaf Daruwala, Omkar Vinay Joshi, Aman Sanjay Singh, Prof.Dr. K. C. Nalavade

**Study Overview:** This paper reviews video conferencing software facilitating visual communication across industries. Existing platforms suffer from connectivity issues affecting audio-visual quality and compatibility issues with browsers and operating systems. Security enhancements via WebRTC address these concerns using protocols like SRTP for encryption and authentication, and Opus codec for high-quality voice transmission.

**Drawbacks:** MYFRAMES, using WebRTC for video conferencing, faces drawbacks such as signaling server complexity, security vulnerabilities, bandwidth management issues, browser compatibility problems, and scalability challenges​ (Stack Overflow)​​.

### I.III Comparative Study of WebRTC Open Source SFUs for Video Conferencing (2018)

**Authors :** Emmanuel Andre, Nicolas Le Breton∗§, Augustin Lemesle∗§, Ludovic Roux and Alexandre Gouaillard (2018)

**Study Overview:** WebRTC SFUs, crucial for Simulcast in WebRTC 1.0, are widely adopted for video conferencing and broadcasting. This paper introduces a novel approach using the KITE testing engine to compare five open-source WebRTC SFUs under load. The study reveals valuable insights into SFU scalability, previously unexplored in scientific research.

**Drawbacks:** As the results are based on a specific testing engine (KITE) and five open-source WebRTC SFUs, which may not represent all use cases or scenarios.

### I.IV DeFake: Decentralized ENF-Consensus Based DeepFake Detection in Video Conferencing (2024).

**Authors :** Deeraj Nagothua, Ronghua Xua, Yu Chena, Erik Blaschb, Alexander Avedb (2024).

**Study Overview:** Current video conferencing lacks real-time media authenticity verification, leaving it vulnerable to deepfake and replay attacks. This paper proposes DeFake, a decentralized audio authentication using Electrical Network Frequency (ENF) signals. The Proof-of-ENF (PoENF) algorithm ensures robust deepfake detection in audio streams with minimal computational overhead, enhancing real-time security for video recordings.

**Drawbacks:** A drawback of the DeFake approach is its reliance on Electrical Network Frequency (ENF) signals, which might be susceptible to variations in signal quality and environmental factors, potentially affecting the accuracy and reliability of deepfake detection.

### I.V DHT- and blockchain-based smart identification for video conferencing (2021).

### **Authors:** Morteza Alizadeh, Karl Andersson, Olov Schelen

**Study Overview:** Video conferencing faces universal challenges in integrity, security, and authentication. This paper proposes a decentralized smart identification scheme using biometrics, machine learning, blockchain, and distributed hash tables. It enhances system storage and immutability, comparing architecture efficiencies with experimental results favoring blockchain and distributed hash tables despite longer execution times.

**Drawbacks:** A drawback of the proposed decentralized smart identification scheme is its longer execution time compared to centralized database architectures, which may impact real-time performance despite improvements in efficiency and storage capacity.

### I.VI DIGIPARTY - A DECENTRALIZED MULTI-PARTY VIDEO CONFERENCING SYSTEM (2018)

**Authors :** Ling Chen, Chong Luo, hang Li, and Shipeng Li

**Study Overview:** Despite advancements since Microsoft NetMeeting, Internet video telephony remains primarily point-to-point. This paper introduces DigiParty, a fully distributed multi-party video conferencing system using a full mesh architecture and a novel conference control protocol. DigiParty aims to provide easy-to-use, global connectivity for families and friends via the Internet, compatible with various internet connections and instant messaging services.

**Drawbacks:** DigiParty system is that its full mesh conferencing architecture may lead to scalability issues, as the system could become inefficient with a large number of participants due to increased resource and bandwidth requirements.

### I.VII End-to-End PQC Encryption Protocol for GPKI-based Video Conferencing System (2023).

**Authors :** Yeongjae Park ,Hyeondo Yoo ,Jieun Ryu ,Young-Rak Choi ,Ju-Sung

Kang and Yongjin Yeom.

**Study Overview:** This paper examines security issues in video conferencing, focusing on end-to-end encryption (E2EE) protocols. It compares Zoom and Secure Frame (SFrame) systems, then proposes an E2EE mechanism using post-quantum cryptography (PQC) Key Encapsulation Mechanism (KEM) for Government Public Key Infrastructure (GPKI)-based systems, enhancing security against future quantum threats.

**Drawbacks:** The proposed PQC KEM mechanism may complicate system integration, introduce performance overhead, and face scalability issues with a large number of users, potentially affecting overall efficiency and user experience.

### I.VIII Video-conference Communication Platform Based on WebRTC Online meetings (2020).

**Authors :** Jelena Caiko, Antons Patlins, Arapov Nurlan, Vladimir Protsenko

**Study Overview:** The shift to remote work during the pandemic has highlighted challenges in video conferencing, particularly for small to medium-sized businesses lacking adequate facilities.This article aims to address these issues by designing and implementing Jitsi, an open- source video conferencing prototype, offering accessible meeting solutions without high costs or space constraints.

**Drawbacks:** Jitsi open source video conferencing prototype is that while it addresses cost and accessibility issues for small and medium-sized businesses, it may still face limitations in scalability and feature robustness compared to commercial solutions.

### I.IX Analysis and Design of Decentralized Conferencing using Wi- Fi based on P2P Architecture(2014).

**Authors :** Aditya Trivedi, Niseant Chaubey

**Study Overview:** This paper explores audio/video calls and conferencing over Wi-Fi with minimal cost, proposing a decentralized approach to avoid single points of failure in client-server architectures. It introduces a peer-to-peer (P2P) model using a mobile number to IP address conversion algorithm, enabling Android-based mobile phones to facilitate WLAN- based audio/video calls and conferencing.

**Drawbacks:** Drawbacks of decentralized conferencing using Wi-Fi in a P2P architecture include limited scalability, potential connectivity issues in low-bandwidth environments, security vulnerabilities, lack of centralized control, and increased complexity in network management.

### I.X A Scalable based Multicast Model for P2P Conferencing Applications MouradAMAD (2019).

**Authors :** Zahir HADDAD, Lachemi KHENOUS, KamalKABYL

**Study Overview:** This paper explores multicast conferencing efficiency and the benefits of Peer-to-Peer (P2P) models for scalability and fault tolerance. It proposes a novel approach combining SIP for call control, Chord for dynamic network organization, and application layer multicast. Performance evaluation shows improved traffic flow and transmission efficiency in conferencing applications.

**Drawbacks:** A drawback of the proposed P2P conferencing model is that while it combines SIP and Chord protocols to enhance scalability and robustness, the dynamic nature of P2P networks may introduce complexities in maintaining consistent performance and stability, especially in fluctuating network conditions.

### II.Conclusion

The proposed decentralized video conferencing web application presents a significant advancement in virtual communication technology by addressing critical issues associated with traditional centralized systems. By leveraging peer-to-peer (P2P) communication, the application enhances user privacy, reduces latency, and eliminates single points of failure. The use of WebRTC facilitates direct, real-time audio, video, and data sharing between browsers, improving the overall user experience. Additionally, integrating smart contracts automates and secures various processes, ensuring transparency and minimizing reliance on third-party intermediaries. This approach not only strengthens security but also supports scalable and robust performance. The application’s innovative design addresses the shortcomings of existing solutions, providing a more reliable and efficient platform for virtual meetings. By offering a secure, private, and high-performance alternative, this project sets a new standard for future video conferencing systems, making it a valuable contribution to the field of digital communication.

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