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Cloud-Based Video Calling System with Secure Recording

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Abstract: *Online video conferencing has transformed the way individual and organisations communicate, providing a real time platform designed to facilitate collaboration in remote environments. The Cloud-Based Video Calling System with Secure Recording is designed to deliver to a secure and efficient communication platform for personal and professional needs. Popular video calling platforms like Zoom and Google Meet enable recording under host control, which can create privacy concerns as participants or users cannot stop or deny the recording once it starts and also participants require to take permission from host to record a video. The system ensures end-to-end encryption for both communication and storage, protecting sensitive data from unauthorized access. By leveraging cloud-based infrastructure, the system offers scalability and controlled access to recorded data using role-based permissions. The system is particularly beneficial for sensitive use cases such as corporate meetings, legal discussions, online education, and telemedicine, where confidentiality and data security are essential. The system integrates cloud storage, encryption mechanisms, and role-based access control (RBAC) to safeguard sensitive data. This abstract explores the motivation, challenges, methodology, and outcomes of the proposed secure video conferencing system.*

Keywords: Video calling, Secure recording, Cloud-based system, End-to-end encryption, Role-based access

I. INTRODUCTION

Online video calling has become an essential tool for communication in today's digitally connected world. Video conferencing is a technology that enables real-time audio and video communication between two or more people located in different places. It allows participants to conduct meetings, webinars, online classes, and virtual collaborations without the need for physical presence. The increasing demand for remote work, virtual collaboration, and online education has accelerated the adoption of video calling platforms.

II. BACKGROUND

The background of the Cloud-Based Video Calling System with Secure Recording is rooted in the growing need for secure and reliable communication in both personal and professional settings. As remote work and virtual meetings become more common, the demand for secure video calling platforms has increased significantly. Existing platforms like Zoom and Google Meet allow recording, but the control lies with the host, which can raise privacy concerns since participants cannot stop or deny the recording once initiated. Additionally, data security issues arise when recordings are not fully encrypted or securely stored.

To address these challenges, this project introduces a secure video calling system that enables recording only with mutual consent using a secure key or code. The system ensures end-to-end encryption during both communication and storage, protecting sensitive information from unauthorized access. By leveraging cloud infrastructure, the system guarantees scalability and provides controlled access to recordings through role-based permissions. This approach enhances user privacy and data security, making the platform suitable for professional use cases such as corporate meetings, legal discussions, online education, and telemedicine.

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The background of this project reflects the evolving need for secure and user-friendly communication platforms. As data privacy and security become more critical, the system addresses these challenges by combining advanced encryption techniques with a user-controlled recording mechanism to deliver a reliable and transparent communication experience.

III. MOTIVATION

The motivation behind developing the Cloud-Based Video Calling System with Secure Recording stems from the need to provide a more secure and transparent communication platform. Existing video calling platforms often give recording control to the host, which can create discomfort and privacy issues for participants. Moreover, the lack of end-to-end encryption for stored recordings increases the risk of data breaches and unauthorized access.

The development of cloud-based video calling system with secure recording with mutual consent-based recording system where all participants must agree before a recording starts. The use of a secure key or code adds an extra layer of protection, ensuring that recordings are encrypted and securely stored in the cloud. By integrating role-based access control, the system limits access to recorded data, protecting sensitive information and enhancing user trust.

IV. LITERATURE SURVEY

The rapid growth of online video conferencing technologies in recent years has garnered significant attention in both academic and industry circles. This literature survey examines key research studies and reports that focus on the development, adoption, benefits, challenges, and future trends in online video conferencing. Several studies trace the evolution of video conferencing from early developments to its current widespread adoption, particularly during the COVID-19 pandemic, when remote communication became essential. Platforms like Zoom, Microsoft Teams, and Google Meet witnessed exponential growth, adapting to rising security and privacy demands. Research highlights multiple security vulnerabilities in existing platforms. For instance, one study proposes a hybrid homomorphic encryption model to ensure confidentiality in video conferencing, though its computational demands pose a challenge for real-time applications. Another study critically analyses Zoom's security threats, particularly regarding host-controlled recording mechanisms, exposing risks of unauthorized data access. A comparative analysis of Zoom, Google Meet, and Microsoft Teams further evaluates encryption and data protection features, identifying gaps that need addressing. In response to these challenges, innovative secure recording solutions have emerged. One study presents a mutual consent recording framework using end-to-end encryption and role-based access control, ensuring that recordings occur only with participant approval. Another research paper suggests an enhanced security framework for Zoom, integrating encryption, secure recording protocols, and user authentication improvements. However, these solutions require further real-world validation to assess their effectiveness.

V. PROBLEM STATEMENT

With the increasing reliance on virtual communication, concerns regarding privacy, data security, and unauthorized recording have become more prominent. Existing video conferencing platforms often provide recording control solely to the host, leading to potential misuse and privacy violations for participants. Additionally, many platforms lack end-to-end encryption (E2EE) for recorded sessions, exposing sensitive conversations to data breaches and unauthorized access. This research aims to develop a cloud-based video calling system that ensures secure, consent-based recording and protects user privacy through advanced encryption techniques. By implementing a mutual consent-based recording mechanism and utilizing cloud security measures, the system will enhance data protection and user control. The study seeks to bridge the gap between convenience and security, providing a scalable, privacy-focused alternative for corporate meetings, legal discussions, online education, and telemedicine.

VI. PROPOSED SYSTEM

The proposed system is a cloud-based video calling platform with an emphasis on security, privacy, and user control over recordings. Unlike traditional video conferencing solutions, this system introduces mutual consent-based recording, ensuring that no session is recorded without the explicit agreement of all participants. Additionally, end-to-

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end encryption (E2EE) is implemented for both real-time communication and stored recordings to prevent unauthorized access. To enhance security and user access control, the system integrates Clerk authentication for seamless and secure user management. Clerk provides a robust authentication framework that supports email/password login, social authentication, and multi-factor authentication (MFA). This ensures that only verified users can join meetings, access stored recordings, and manage permissions. Furthermore, role-based access control (RBAC) is implemented to regulate data accessibility based on user roles, such as host, participant, and administrator. The system is designed for scalability and flexibility, utilizing cloud infrastructure to support large-scale usage while maintaining high-quality video streaming. To further protect user privacy, recordings are securely stored with encryption keys managed by the participants, preventing unauthorized decryption. These measures collectively create a secure, transparent, and privacy-focused video communication platform suitable for professional applications such as corporate meetings, legal discussions, online education.

VII. SYSTEM ARCHITECHTURE

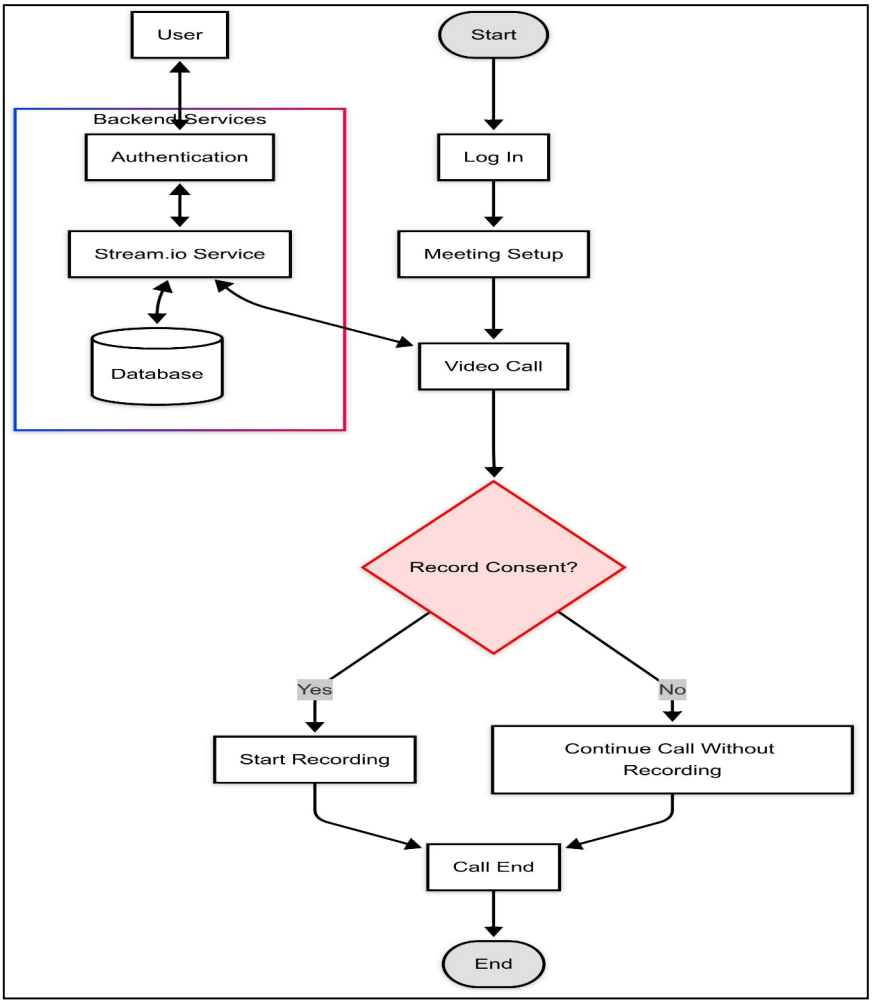

Figure 1: System Architecture

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VIII. WORKFLOW

The workflow of the cloud-based video calling system ensures seamless real-time communication while maintaining security, privacy, and efficiency. The key steps involved in the system are as follows:

User Authentication & Access Control

- Users register and log in using secure authentication methods.
- Access control mechanisms ensure only authorized users can initiate or join calls.

Session Initialization

- A user initiates a video call request, which is processed by the cloud server.
- A unique session ID is generated, and meeting links are shared with participants.

Media Stream Setup

- The system establishes peer-to-peer (P2P) or cloud-based relay connections using WebRTC.
- Audio and video streams are captured, encoded, and transmitted securely.

Consent for Recording (If enabled)

- Before recording starts, participants receive a consent dialog (as seen in the provided screenshot).
- If all participants provide consent, the recording feature is activated.
- If any participant declines, recording remains disabled for privacy compliance.

Real-Time Communication & Collaboration

- Users interact via high-quality video and audio streams.
- Features like screen sharing, chat messaging, and participant management enhance collaboration.

Encryption & Security Measures

- End-to-end encryption (E2EE) protects transmitted data.
- Network security protocols prevent unauthorized access and data breaches.

Call Termination & Data Management

- Upon call completion, the session is terminated, and media streams are stopped.
- If recording was enabled, the video file is stored securely in the cloud.
- Metadata (timestamps, participants, call duration) is logged for analytics and auditing.

Post-Call Services

- Users can access call logs, recorded videos.
- AI-powered analytics can provide insights into call quality and user engagement.

IX. METHODOLOGY

The development of the cloud-hosted video calling application with recording consent follows a structured approach to ensure scalability, security, and efficiency. The process begins with requirement analysis, where user needs and privacy concerns are studied to define key functionalities such as real-time video calls, user authentication, recording management, and consent handling. The system adopts a cloud-based multi-tier architecture, with the frontend built using Next.js and TypeScript, the backend managed via Next.js API routes, and Stream.io handling real-time communication and recording storage. User authentication is implemented using Clerk, ensuring secure access control and session management. A custom event-driven consent mechanism is integrated to enforce privacy compliance, requiring all participants to approve before recording begins. For deployment, the system is hosted on Vercel, ensuring optimized performance and auto-scaling. WebSocket's and event listeners are used for real-time updates. Agile development methodology ensures continuous iteration, with functional, performance, and security testing conducted using Jest, Cypress, and manual UAT.Future enhancements include AI-powered transcription services, advanced recording analytics, and third-party integrations, making the platform more intelligent and user-friendly. This methodology ensures a scalable, secure, and privacy-focused cloud-based video calling experience.

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X. RESULTS

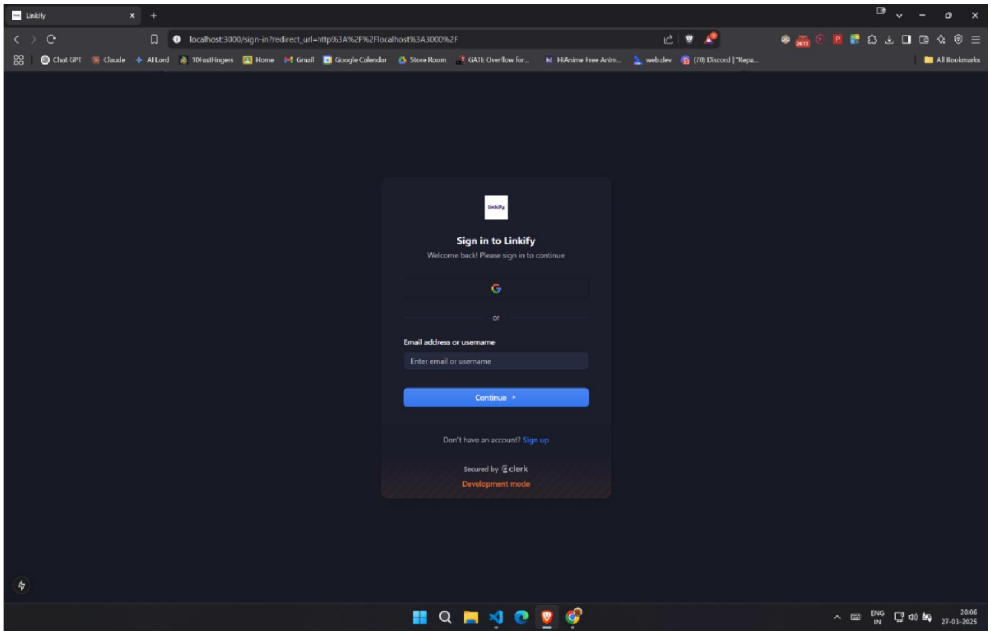

Figure 2: Login/Signup Page

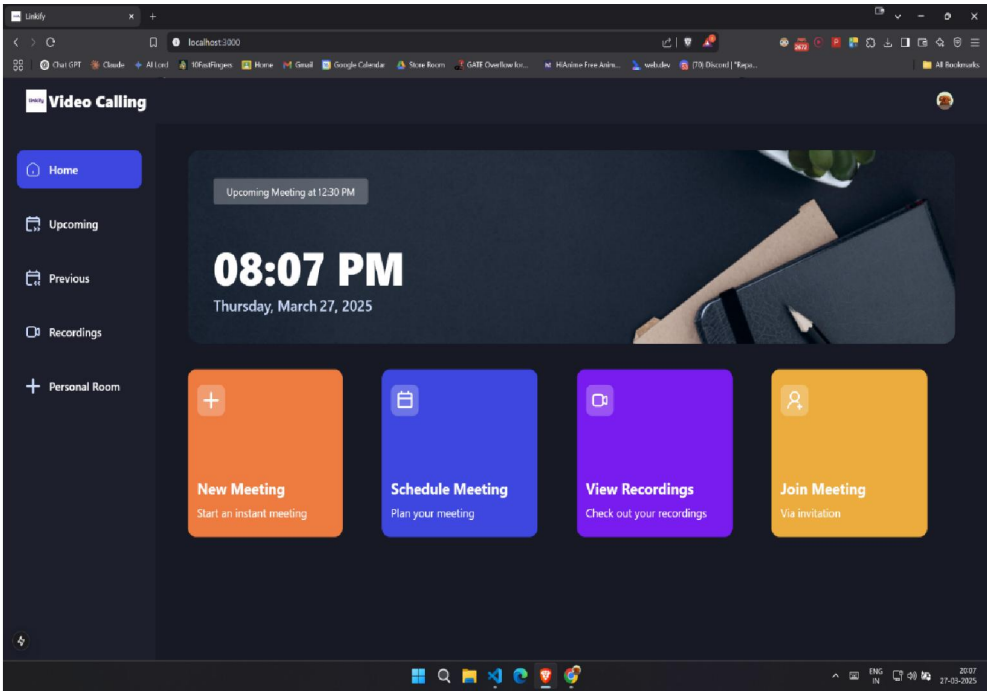

Figure 3: Homepage

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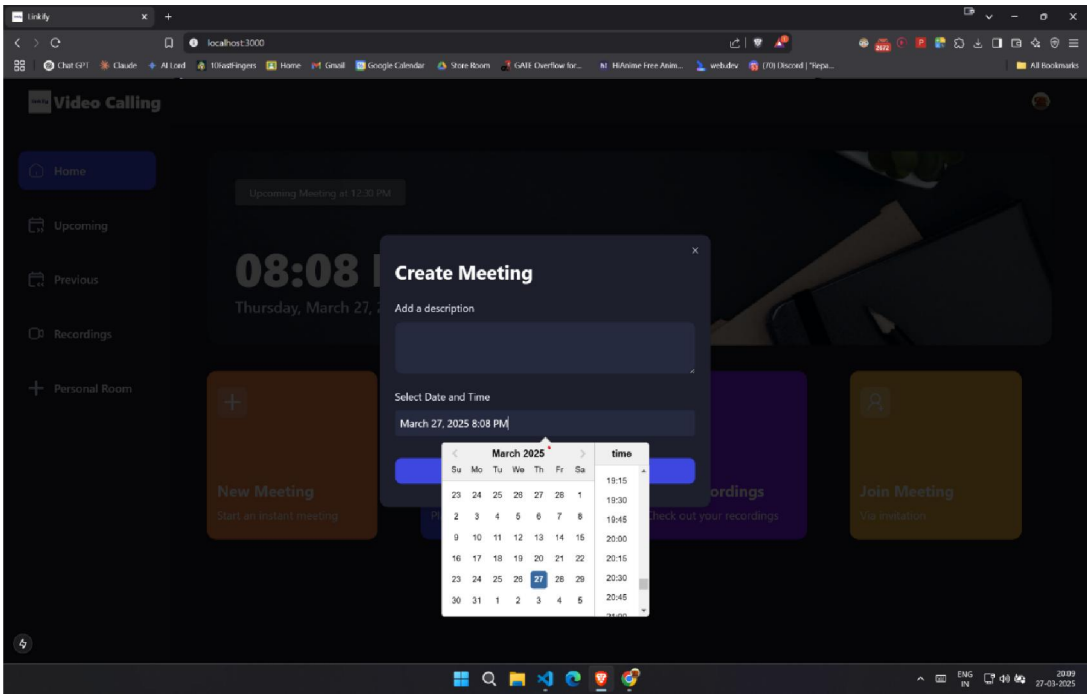

Figure 4: Schedule Meeting

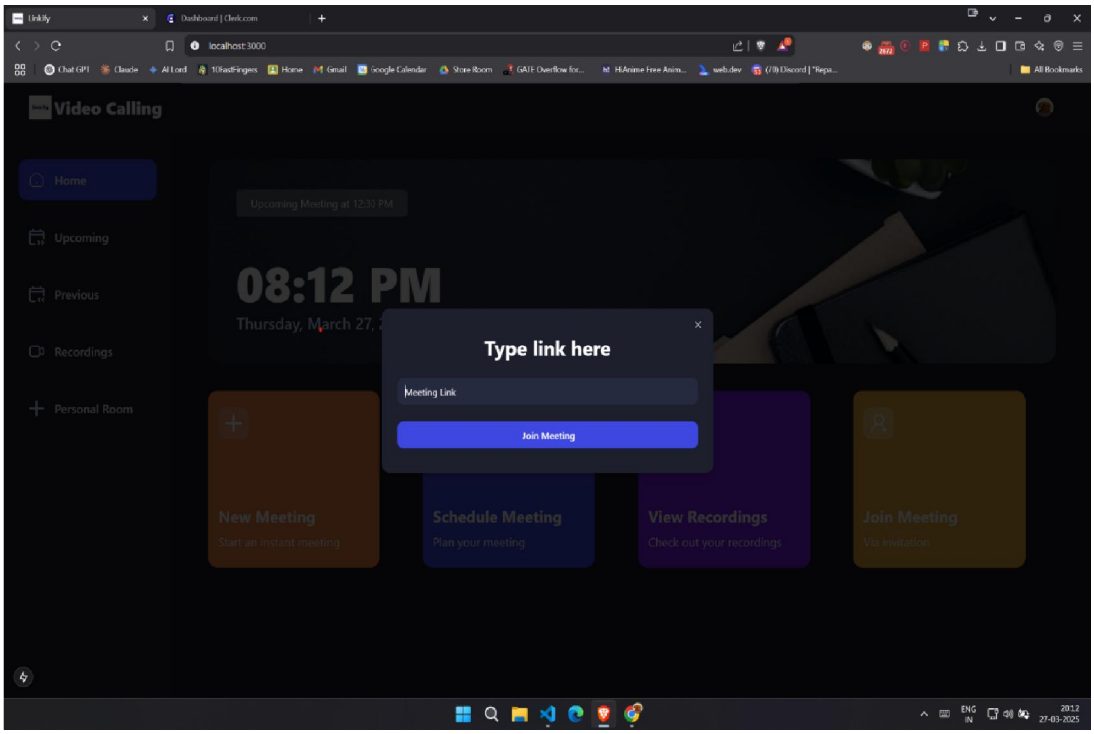

Figure 5: Join Meeting

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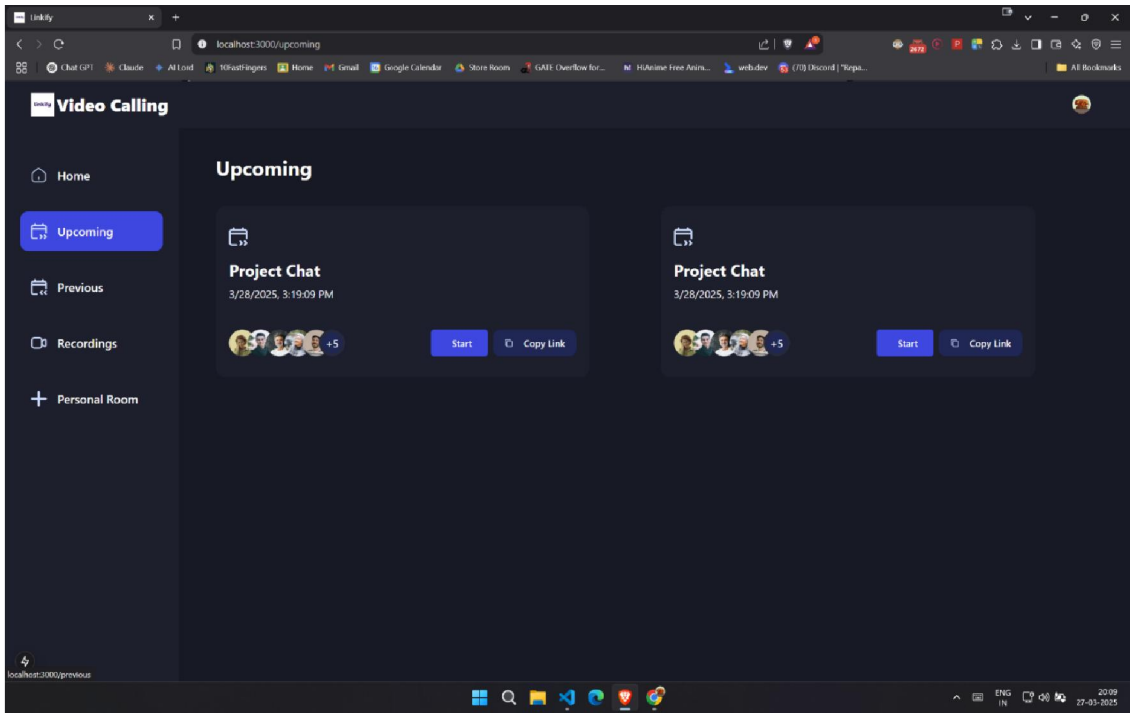

Figure 6: Upcoming Meeting Page

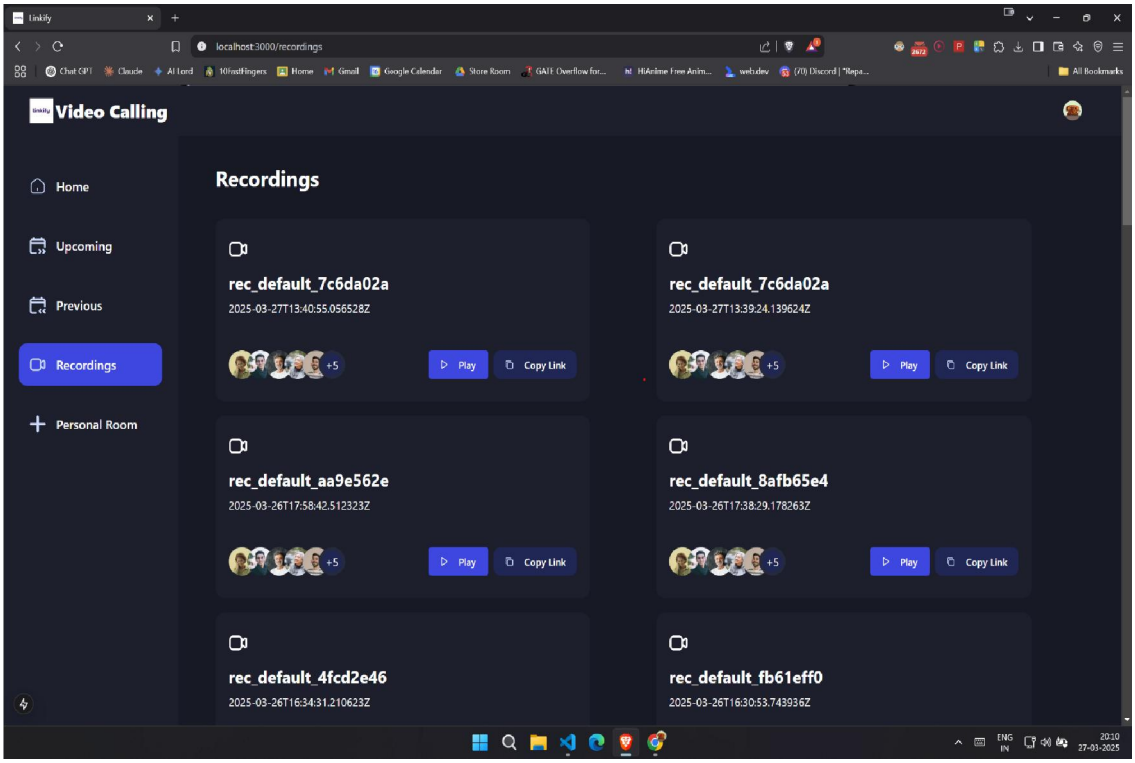

Figure 7: Recordings List Page

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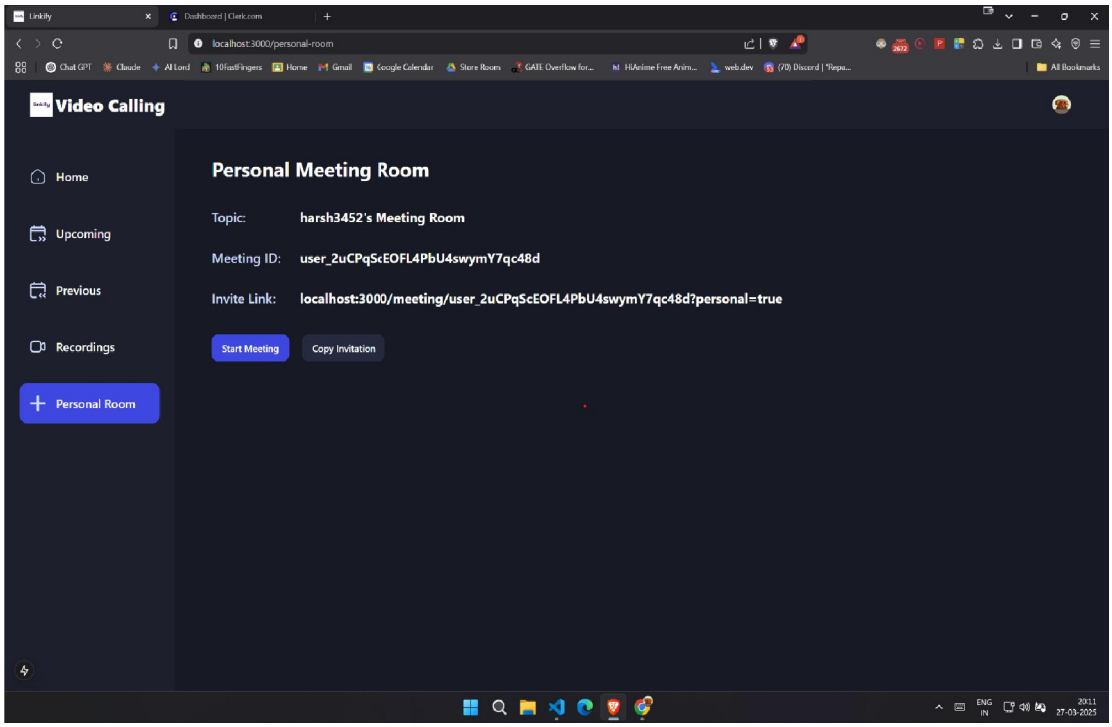

Figure 8: Personal Meeting Page

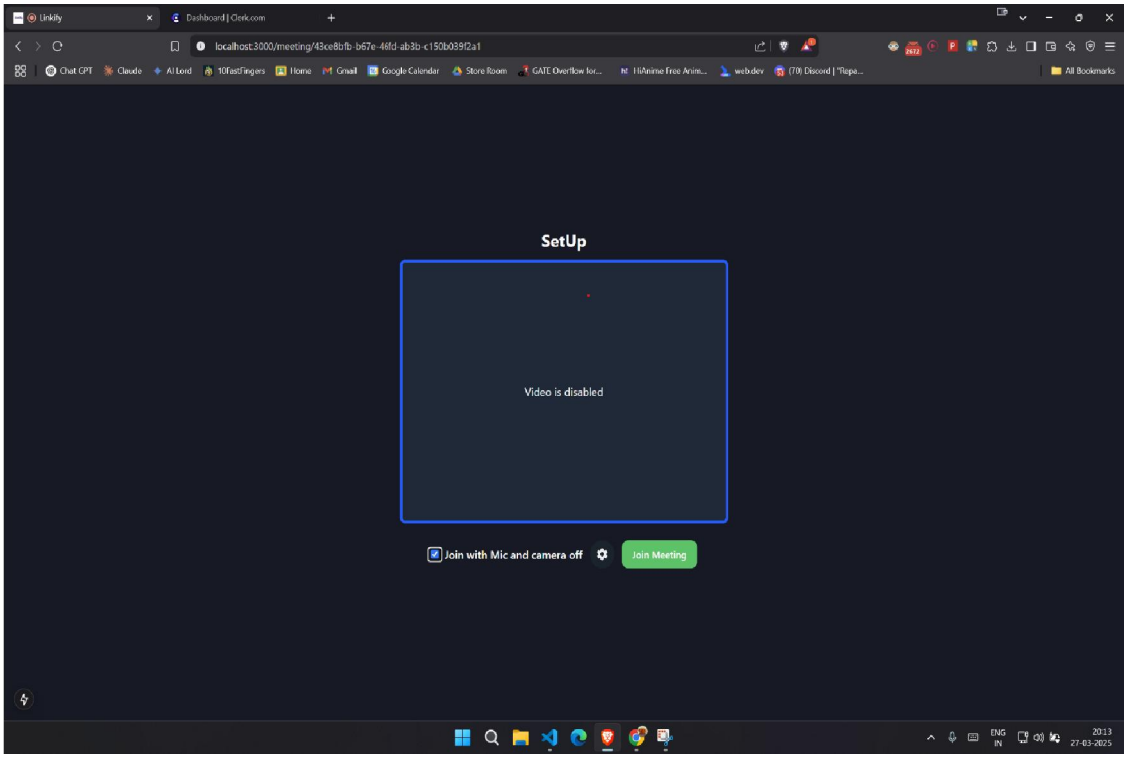

Figure 9: Meeting Setup Page

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Figure 10: Camera-Mic Controls

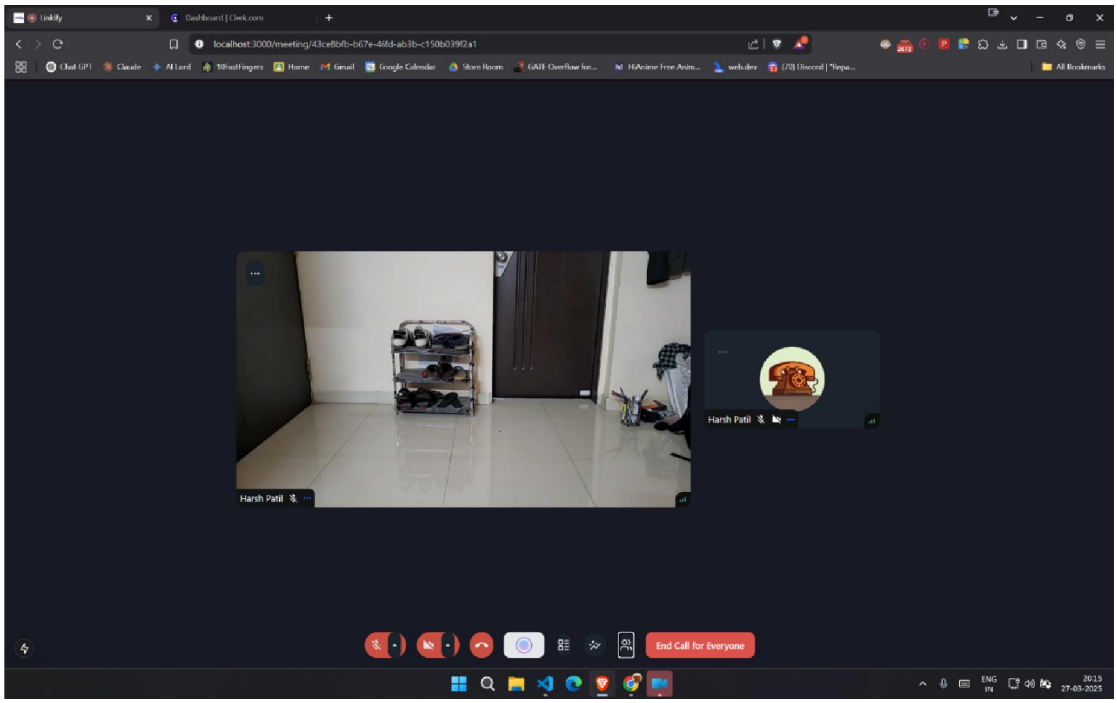

Figure 12: Meeting Room

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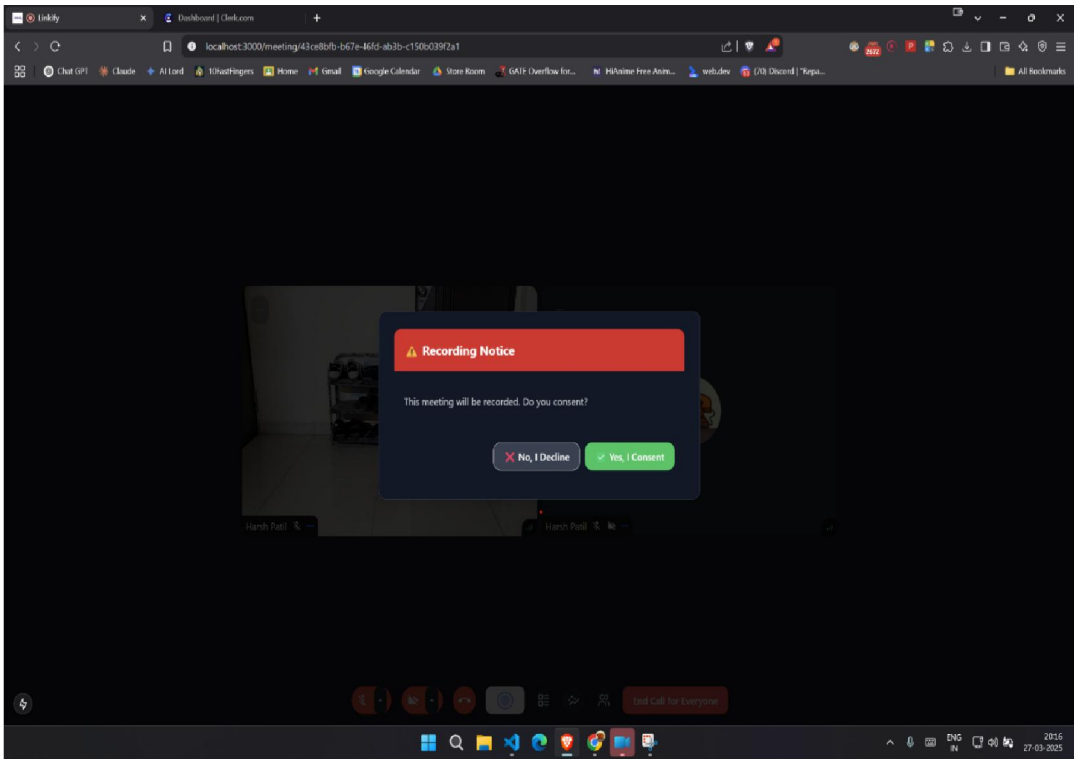

Figure 12: Recording Consent Dialog

XI. CONCLUSION

This paper presents a cloud-based video calling system with features like instant meetings, scheduled meetings, and recording consent mechanisms to ensure user privacy and security. The structured workflow enhances usability, providing seamless meeting experiences with intuitive controls for audio, video, and recording. Through extensive testing, the system has demonstrated efficient performance, minimal latency, and secure authentication, making it a reliable solution for virtual communication. The implementation of a recording consent dialog reinforces ethical practices in online meetings. Future improvements may include AI-based noise cancellation, enhanced encryption, and deeper integrations with third-party services for a more robust experience. Overall, this system successfully addresses the key challenges of video conferencing, offering a secure, user-friendly, and scalable platform for online collaboration.

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