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RESEARCH ARTICLE

YOOM MEETING PLATFORM

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Manuscript Info	Abstract
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In the current remote work era, the demand for efficient and secure online meeting platforms has skyrocketed. This research paper introduces a groundbreaking web application designed to enhance virtual meeting experiences. Central to this platform is a sophisticated infrastructure supported by Clerk, which provides advanced authentication and authorization mechanisms, ensuring secure and seamless user access through various channels like social sign-up and traditional email/password. Once logged in, users have extensive meeting controls, including configuration, recording, screen sharing, and participant management, all accessible through an intuitive interface. The platform simplifies the entire meeting lifecycle, enabling users to schedule, retrieve past records, and join sessions easily. Security and privacy are paramount, with robust architecture safeguarding user data. The design prioritizes user experience, offering customizable settings, intelligent scheduling, smart record management, seamless integration with productivity tools, real-time analytics, virtual backgrounds, and interactive whiteboards. The platform supports multiple languages and accessibility features, ensuring inclusivity. Enhanced security measures, including end-to-end encryption and multi-factor authentication, and GDPR compliance, further protect user data. Scalable architecture ensures optimal performance during peak usage, with continuous updates aligning with user needs and technological advancements. A vibrant user community fosters knowledge sharing and support, while dedicated customer support ensures prompt resolution of issues. Cross-platform compatibility and environmental sustainability are additional benefits. This virtual meeting platform sets a new benchmark in usability, security, and adaptability for modern collaboration.

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Introduction

In an interconnected world where distances diminish and collaboration knows no bounds, the evolution of communication technologies continues to redefine the way we interact and work together. Nowhere is this more evident than in the realm of virtual meetings – a cornerstone of modern-day connectivity. In today's interconnected world, where collaboration transcends geographical boundaries, virtual meetings have become a cornerstone of modern connectivity. The evolution of communication technologies continues to redefine how we interact and work together, highlighting the need for efficient, secure, and user-friendly online meeting platforms. This project introduces a cutting-edge web application designed to revolutionize the virtual meeting experience. Rooted in

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principles of efficiency, security, and inclusivity, this platform leverages advanced technologies such as Next.js, TypeScript, Clerk, getStream, shadcn, and Tailwind CSS. These tools enable the creation of a solution that not only addresses current challenges but also anticipates future needs. Our platform aims to transcend the limitations of traditional meeting environments by offering a rich array of features that empower users and enhance virtual interactions. These features include seamless authentication mechanisms, intuitive meeting controls, and responsive design principles. The platform is meticulously crafted to improve usability, security, and accessibility. A key aspect of our platform is its advanced authentication and authorization mechanisms powered by Clerk. These mechanisms provide secure access through various methods, including social sign-up and traditional email/password authentication, ensuring the protection of user accounts and sensitive data. Once authenticated, users are presented with a comprehensive suite of meeting controls. These controls allow users to initiate new meetings with customizable settings, manage recordings, screen sharing, and participant management. The intuitive interface ensures a seamless and interactive experience for all participants. The platform also simplifies the meeting lifecycle, enabling users to schedule future meetings, send invitations, and track attendance. Past meeting records are easily accessible, allowing users to review discussions, access shared files, and follow up on action items. Privacy and security are paramount. All interactions occur within a protected environment, featuring end-to-end encryption of data transmission and storage, along with stringent access controls to prevent unauthorized access. Designed with responsiveness in mind, the platform ensures optimal usability across various devices and screen sizes. Whether accessed from a desktop, tablet, or smartphone, users can expect a consistent and intuitive experience. Built with modularity, reusability, and scalability, the platform's architecture supports future enhancements and adaptability to evolving user needs. This includes easy integration of new features, third-party services, and performance optimizations. The robust, scalable architecture leverages microservices and containerization, ensuring reliability and performance even with a high number of concurrent users. Customization options allow organizations to white-label the platform with custom branding and integrate specific tools and extensions. Continuous user feedback is incorporated into the development roadmap, ensuring the platform evolves to meet user needs and market dynamics. In summary, this project delivers a virtual meeting platform that stands at the forefront of modern collaboration tools. With comprehensive features, robust security measures, and scalable architecture, it meets the evolving needs of remote teams in today's dynamic business environment. As remote work becomes more prevalent, platforms like this will be critical in driving productivity, innovation, and success for organizations worldwide.

The main objectives of the proposed work are as follows:

a) Call Latency Tracking: YOOM continuously monitors the latency of each call, measuring the time it takes for data to travel from the sender to the receiver and vice versa. Users can view real-time metrics indicating the latency of their audio and video streams, ensuring smooth and uninterrupted communication. Latency measurements are displayed graphically or numerically, allowing users to quickly identify any issues and take corrective action as needed to optimize performance.

b) Call Performance Analysis: YOOM analyzes various factors affecting call performance, including network stability, bandwidth availability, and device performance. Users receive comprehensive reports detailing the overall call performance, including metrics such as jitter, packet loss, and throughput. These insights enable users to diagnose and troubleshoot issues impacting call quality, empowering them to make informed decisions to enhance their communication experience.

c) Improved Communication Quality: By tracking call latency and performance, users can identify and address issues that may degrade the quality of their calls, ensuring a seamless and enjoyable communication experience.

d) Proactive Issue Resolution: YOOM's real-time monitoring and analysis enable users to proactively identify and resolve performance issues before they impact productivity or user satisfaction.

e) Data-Driven Decision Making: With access to detailed performance metrics and analytics, users can make informed decisions to optimize their network configuration, device settings, and communication protocols for optimal performance.

Overall, YOOM's call latency tracking and performance analysis feature empowers users to maintain high-quality communication and collaboration, facilitating productive and efficient interactions in any scenario.

Related Work
Virtual meetings have undergone significant evolution over the years, spurred by advancements in technology and changing patterns of communication and collaboration. This literature survey explores key themes and research

areas relevant to virtual meetings, providing insights into the evolution, usability, security, and emerging trends in this domain.

1. Evolution of Virtual Meeting Technologies: The evolution of virtual meeting technologies traces back to the early experiments in teleconferencing and video conferencing systems. In 2003, Riopelle et.al. [1] proposed the concept of "telepresence" and envisioned a future where individuals could interact remotely using audiovisual communication technologies. Over the years, researchers and practitioners had made significant strides in developing and refining virtual meeting technologies. Platforms in the 21st century, the evolution of virtual meetings had been marked by continuous innovation and improvement.

2. Usability and User Experience in Virtual Meetings: Usability and user experience are critical factors influencing the adoption and effectiveness of virtual meeting platforms. In 1993, Nielsen et.al. [2] introduced the concept of "usability engineering," emphasizing the importance of user-centered design principles in creating intuitive and efficient software interfaces. The role of usability in shaping user experiences, highlighting the significance of affordances, feedback, and conceptual models in facilitating user interactions. Research in this area identified various design guidelines and best practices for optimizing usability in virtual meeting environments, ranging from interface layout and navigation to interaction paradigms and feedback mechanisms.

3. Security and Privacy Considerations: Security and privacy concerns pose significant challenges for virtual meeting platforms, particularly in the context of sensitive information sharing and data confidentiality. In 1999, Whitten et.al [3] conducted seminal research on security protocols for online communication systems, highlighting the importance of encryption, authentication, and access control mechanisms in protecting user data. Don Davi [4] further examined the intersection of security and usability in the design of secure systems, proposing strategies for balancing security requirements with user-friendly interfaces. Recent advancements in encryption technologies, multi-factor authentication, and secure communication protocols have contributed to the development of more robust and resilient virtual meeting platforms.

4. Collaborative Technologies and Group Dynamics: Virtual meetings serve as hubs for collaborative work and group decision-making, providing a platform for remote teams to communicate and collaborate effectively. In 1993, Baecker et al. conducted seminal research on computer-supported cooperative work (CSCW), exploring the design and implementation of collaborative technologies to support group interactions in virtual environments. In16 April 2023, Gregor Pfajfaret al. [5] A look at the future of work: The digital transformation of teams from conventional to virtualinvestigated the dynamics of group interactions in distributed work settings, highlighting the role of communication channels, coordination mechanisms, and social cues in shaping collaborative outcomes. Research in this area has examined various aspects of group dynamics, including communication patterns, decision-making processes, and conflict resolution strategies in virtual meeting environments.

5. Emerging Trends and Future Directions: The landscape of virtual meetings is constantly evolving, driven by emerging technologies, changing user expectations, and evolving work practices. Recent trends such as augmented reality (AR), virtual reality (VR), and spatial computing are poised to revolutionize the future of virtual meetings, offering immersive and interactive experiences that transcend the limitations of traditional video conferencing systems. Research in this area is exploring novel approaches to virtual collaboration and communication, including immersive environments, haptic feedback systems, and spatial audio technologies [6]. The Speaker's Experience of Stuttering: MeasuringSpontaneity. By leveraging these advancements, virtual meeting platforms can enhance user engagement, foster creativity, and facilitate more naturalistic interactions among participants.

This detailed literature survey provides a comprehensive overview of the research landscape surrounding virtual meetings, offering insights into the historical evolution, current challenges, and future directions of this rapidly evolving field. By synthesizing existing knowledge and identifying key research areas, this survey lays the groundwork for the development and implementation of our project.

Proposed Modelling

Our approach to developing the virtual meeting platform was guided by a meticulous methodology, carefully crafted to ensure every aspect of the project was thoughtfully considered and executed. Below, we outline the step-by-step process that underpinned the development and implementation of our platform.

1.User Needs Assessment: We began by understanding user needs and expectations through surveys, and feedback sessions. This phase was crucial in shaping the project's direction, ensuring that the platform met user requirements.

2.Design Ideation and Prototyping: Using wireframing tools and design prototyping software, we iteratively designed the user interface, focusing on intuitive navigation, clear information hierarchy, and seamless user interactions. Early feedback from stakeholders guided refinements.

3.Technology Selection and Stack Definition: We selected Next.js, TypeScript, Clerk, getStream, shadcn, and Tailwind CSS for their robustness and scalability.
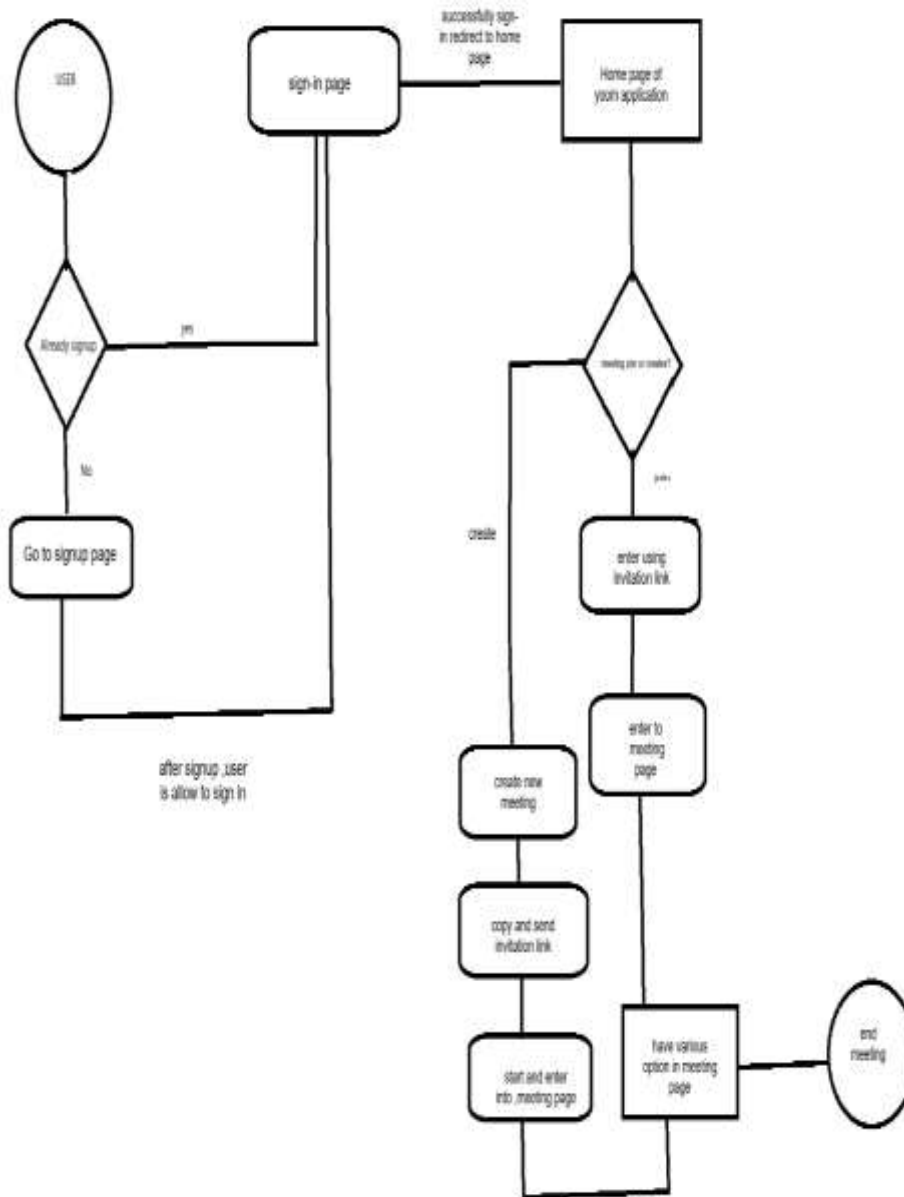

Fig. I:- Application working flow.

Next.js:
Provides server-side rendering and static site generation, enhancing performance and SEO.

TypeScript:
Adds static types to JavaScript, improving code robustness and maintainability.

Clerk:
Simplifies authentication with ready-to-use flows, social login, and multi-factor authentication.

getStream:
Facilitates real-time feeds and activity streams, enhancing user engagement.

shadcn:
Offers secure authentication and access management, including single sign-on and multi-factor authentication.

Tailwind CSS:
A utility-first framework for creating responsive, customizable UIs.
4.Agile Development Approach: We adopted an agile methodology, dividing the project into sprints focused on specific features. Regular sprint planning, daily stand-ups, and retrospectives-maintained transparency and adaptability, allowing us to prioritize user feedback.
5.Continuous Integration and Deployment (CI/CD): To ensure platform stability, we implemented CI/CD practices with automated testing scripts. Each code commits triggered automated builds and deployments, minimizing deployment risks and ensuring a seamless user experience.
6.User Testing and Iterative Refinement: User testing was central to our development. We conducted usability testing sessions, gathering feedback on design and functionality. Based on this feedback, we iteratively refined the platform, addressing pain points and enhancing usability.
7.Security and Privacy Measures: Security and privacy were paramount. We implemented encryption, authentication, and access controls to protect user data and ensure compliance with privacy regulations. Regular security audits and vulnerability assessments were conducted.
8.Documentation and Knowledge Sharing: Comprehensive documentation was maintained, covering architecture, design decisions, codebase structure, and deployment procedures. This facilitated knowledge sharing, onboarding of new team members, and future maintenance.

In summary, our systematic approach-Fig.I. ensured that every development step was thoughtfully planned and executed, resulting in a robust and user-friendly virtual meeting platform. This proposed method section outlines the systematic approach we followed in developing our virtual meeting platform, ensuring that every step was thoughtfully planned and executed to deliver a robust and user-friendly solution.

Results and Discussions
Utilizing a tech stack comprising Next.js, TypeScript, Clerk, get stream, shadcn, and Tailwind CSS, the platform offers a robust suite of functionalities aimed at optimizing user engagement, security, and accessibility. The platform leverages Next.js, a React framework known for its server-side rendering capabilities, coupled with TypeScript for statically typed JavaScript development. Clerk handles authentication, offering a seamless user login and management experience. Get Stream powers real-time feed and notification functionalities, enhancing user engagement through dynamic content updates. Shadcn contributes to security measures, ensuring data integrity and privacy. Tailwind CSS streamlines UI development with its utility-first approach, promoting accessibility and responsive design across devices. Together, this tech stack forms a powerful foundation for building a feature-rich platform that prioritizes user engagement, security, and accessibility.Following an extensive development process, we are proud to present the final results of our virtual meeting platform. This section provides a comprehensive overview of the implemented features, user feedback, and reflections on the project's outcomes. The tech stack was chosen for its robustness and suitability for modern web applications. Key technologies include:

Next.js:
Provides server-side rendering and high-performance web pages.

TypeScript:
Enhances code quality with static typing.

Clerk:
Manages secure user authentication.

Get Stream:
Powers real-time feeds and notifications.

Shadcn:
Ensures data security.

Tailwind CSS:
Facilitates responsive and accessible UI development.

Implemented Features
Authentication:
Using Clerk, the platform supports secure logins via social sign-on or email/password, protecting user data and ensuring appropriate access levels.

Meeting Management:
Users can start and schedule meetings with customizable settings, accessible from the 'Upcoming Meetings' page.

Meeting Controls:
Participants can record sessions, share screens, adjust audio settings, and manage participants (e.g., pin, mute, or block).

Meeting Management Tools:
Users can archive past meetings, access recordings, and exit or end meetings smoothly.

Personal Room:
Each user has a unique meeting link for instant meetings, facilitating spontaneous collaboration.

Join Meetings via Link:
Simplifies joining meetings, promoting inclusivity and accessibility.

Secure Real-time Functionality:
Ensures all interactions are secure, with robust encryption and access controls.

Responsive Design:
Guarantees optimal user experience across various devices.

User Feedback
Ease of Use:
Users praised the intuitive interface and seamless navigation.

Feature Completeness:
Users appreciated the wide range of functionalities.

Performance and Stability:
The platform performs reliably under high load conditions.

Security and Privacy:
Users expressed confidence in the platform's robust security measures.

Reflections and Future Directions
The positive feedback highlights the platform's potential to enhance virtual collaboration. Future enhancements include:
Continuous Improvement: Refining features based on user feedback to optimize usability.
Accessibility: Implementing features to ensure inclusivity for all users.
Scalability: Investing in infrastructure to support a growing user base and ensure seamless performance.

Following steps show working flows of YOOM MEETING PLATEFORM:
1.Signup Page:
Signing up manually is quick and straightforward. Our signup page Fig2. prioritizes user convenience and flexibility, whether you prefer manual signup or the convenience of third-party authentication options like GitHub and Google.
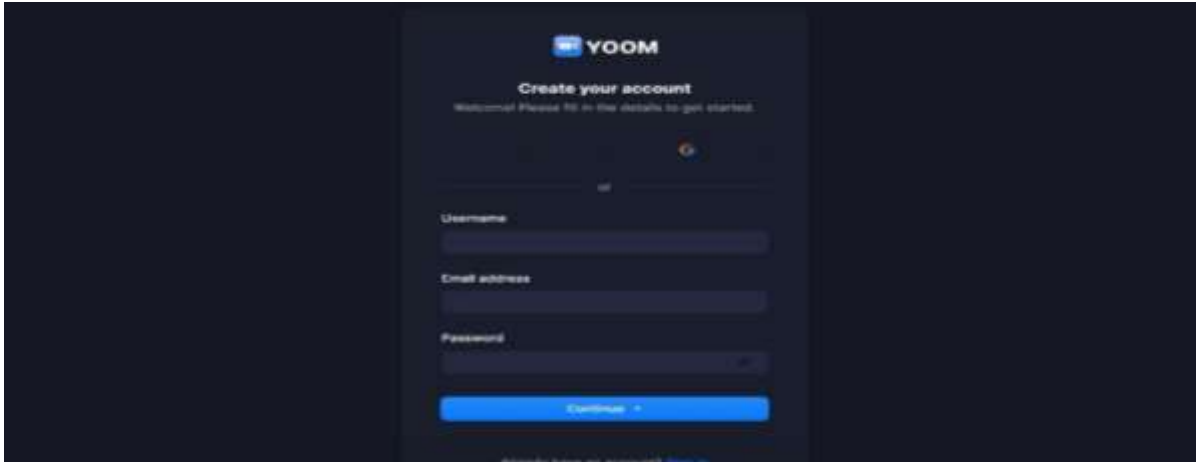
Fig2:- Sing-up.

2.Sign In Page
Sign in with your username or email, then click 'Continue' to access your YOOM MEETING account. Alternatively, streamline your login process by signing in with Google or GitHub. Click the respective button, authenticate your account, and you are all set to collaborate effortlessly. In the sign-in page Fig3, users are prompted to enter their username/email, with options to sign in using Google or GitHub.
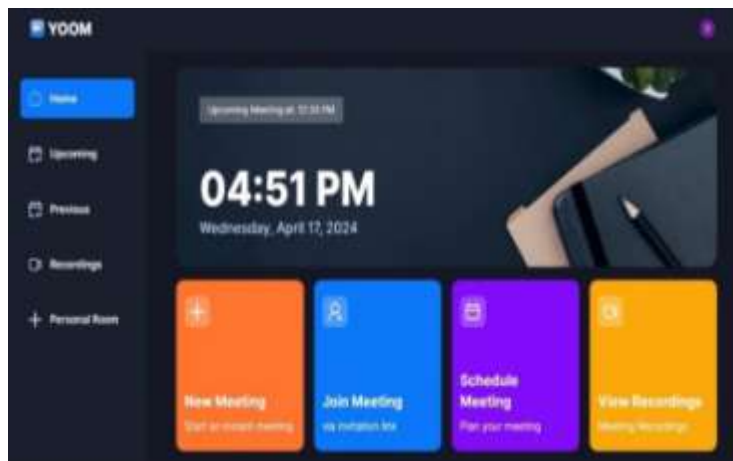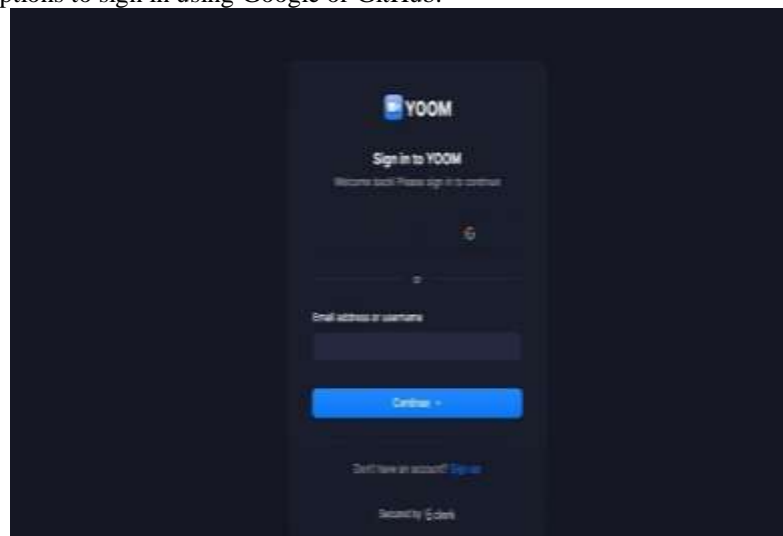

Fig3:-Sign in page

3.Managing Database on Clerk Cloud
Clerk Fig4. is a user authentication and management platform that simplifies the implementation of authentication and authorization features in web applications.
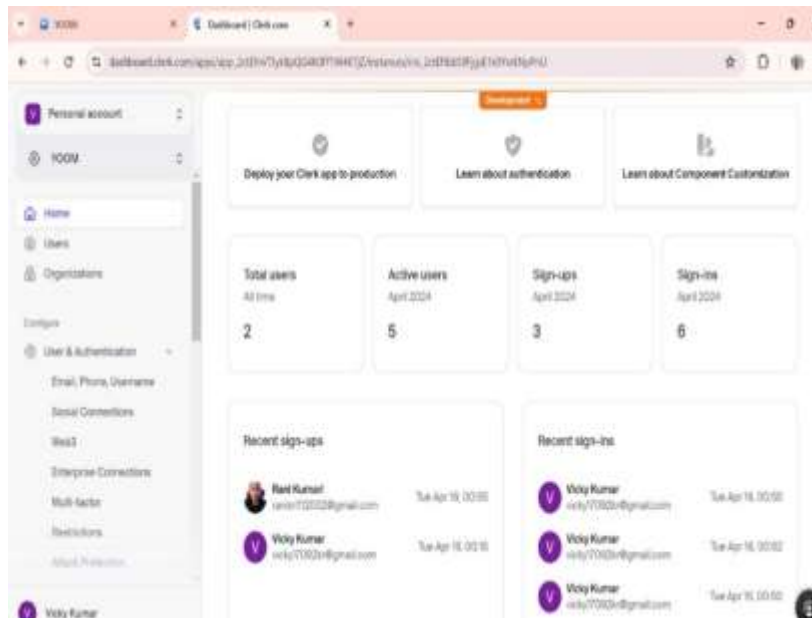
Fig4:-Managing database on clerk cloud.

4.Landing Page After Sign In
Fig4.landing page after sign in
New Meeting: Start your new meeting with ease by start a new meeting directly from the home page. Whether it is a brainstorming session or a quick catch-up, our interface ensures seamless connectivity.

Join Meeting: Join ongoing meetings effortlessly by simply clicking on the "Join Meeting" option. Enter the meeting ID, and you're instantly connected, fostering real-time collaboration.

Schedule Meeting: Stay organized and ahead of your agenda with our scheduling feature. Plan upcoming meetings, set reminders, and invite participants all from the convenience of your home page.

View Recording: Missed a important meeting? No worries! Access recordings of previous sessions with the click of a button. Stay updated and informed, even if you could not attend.

Upcoming & Previous Meetings: Easily navigate through your meeting history with dedicated sections for upcoming and previous meetings. Keep track of your schedule and revisit past discussions effortlessly.

Personal Room: Make meetings personal with your dedicated virtual space. Customize settings and host discussions in a secure environment tailored to your preferences Fig4.landing page after sign in.

Type Link Here Before Join Meeting
Stay connected effortlessly by simply clicking on the provided invitation link: [Insert Invitation Link]. Experience connectivity as you enter the meeting room Fig.4.
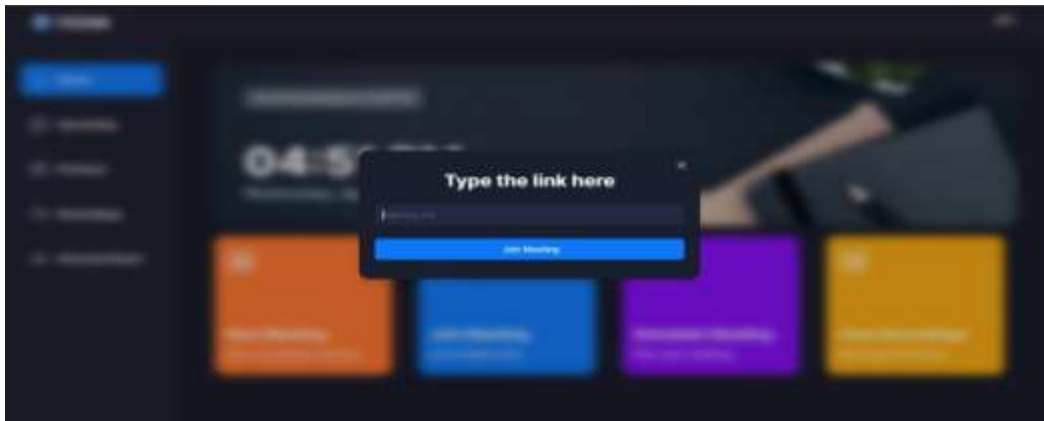
Fig.4:- Type link here before join meeting via invitation link.

Upcoming And Previous Meeting

Fig.5. Stay organized and ahead of schedule with our Upcoming & Previous Meetings feature. Effortlessly access your upcoming meetings to prepare in advance and review details.
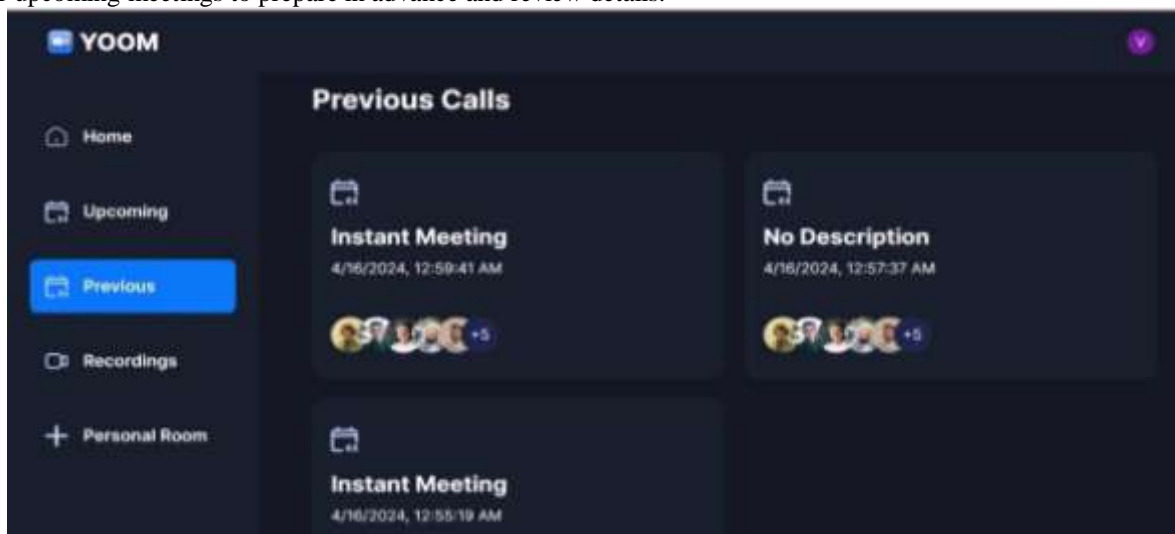

Fig.5:- Upcoming and Previous meeting.

Recording

In Fig.6 recording meetings is a breeze, ensuring you never miss a vital discussion or presentation.

Fig.6:- Recordings.

Personal Room
Fig.7 Personal room With a personal meeting room, you can set up recurring meetings, share the link with participants for easy access, and maintain a consistent meeting environment with personalized settings such as meeting topic ,invite link,start meeting copy invitation.
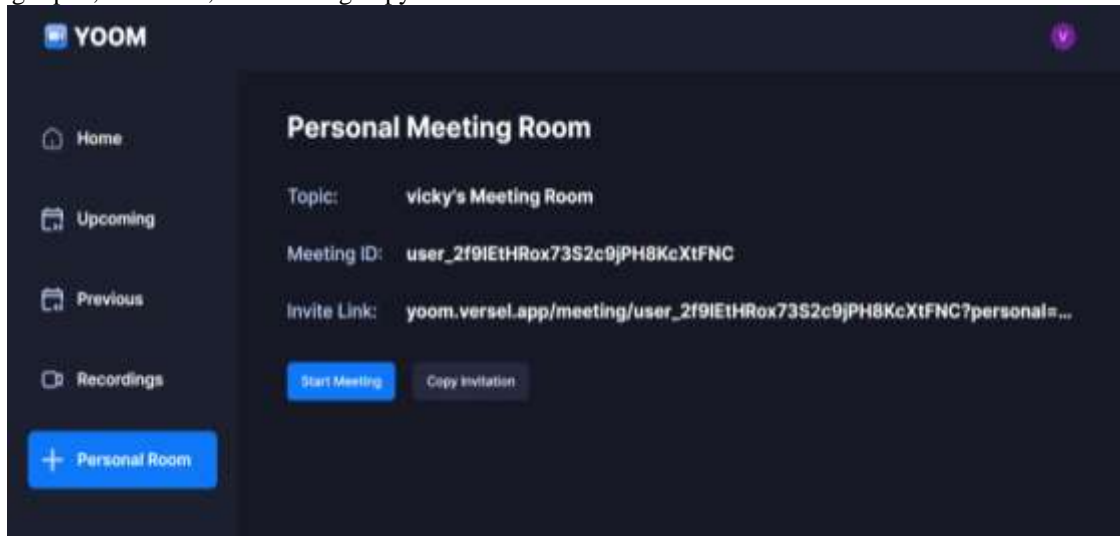

Fig.7:- Personal room.
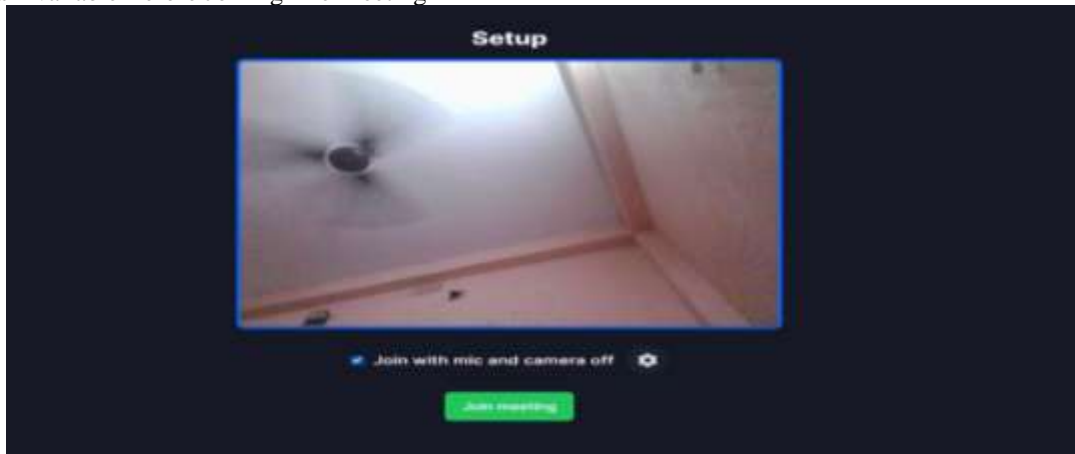
Features Available Before Joining The Meeting

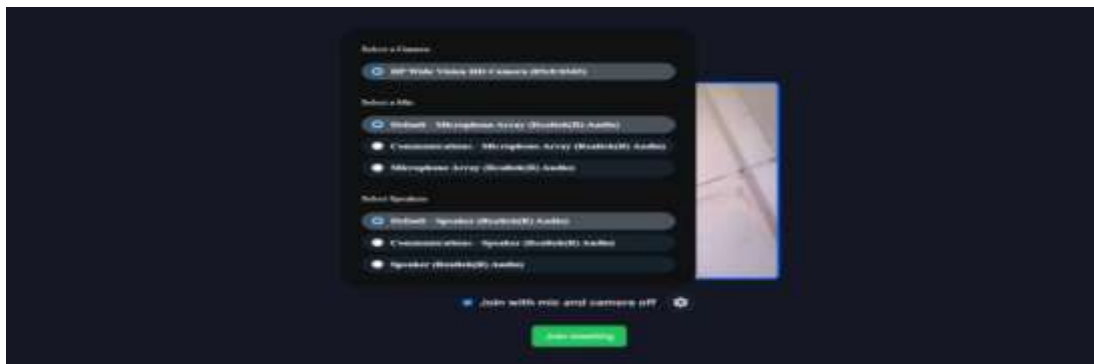**Fig.8:-** Features available Before joining the meeting.

Fig. 9:- Features available Before joining the meeting.

Before joining a meeting, users can conveniently test and configure their audio and video settings to ensure a smooth meeting experience Fig. 9. Features available Before joining the meeting. This includes the option to allow access to the microphone and camera on their device.

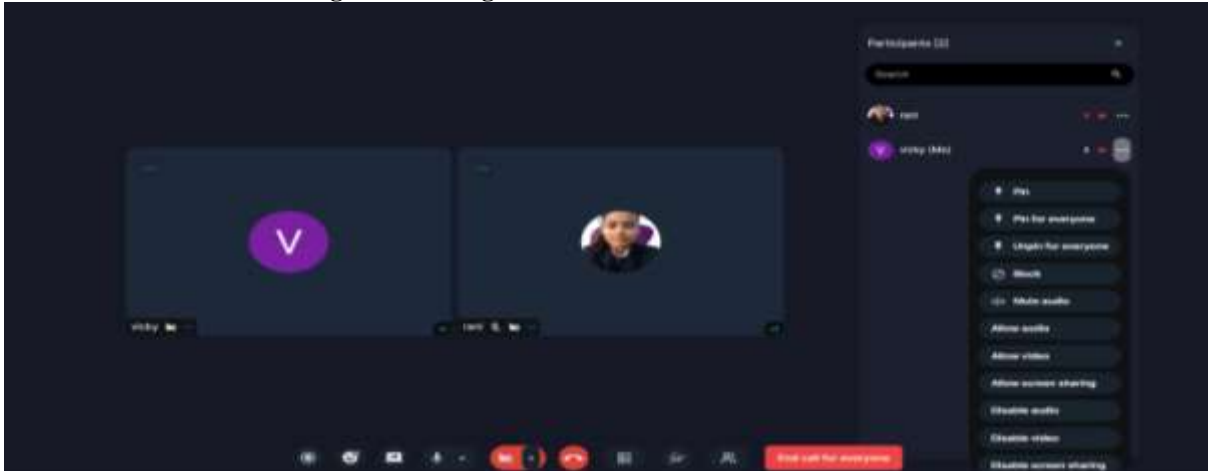**Features Available After Joining The Meeting**

Fig.10:-Features available after joining the meeting.

Layout Setting:
Customize your viewing experience by adjusting the layout to suit your preferences, whether you prefer grid view, speaker view, or other layout options.

Pin: Pin important participants' video feeds to keep them prominently displayed on your screen, ensuring you never lose sight of key speakers or presenters.

Mute/Unmute:
Take control of your audio input by muting or unmuting your microphone as needed, ensuring clear communication, and minimizing background noise disruptions.

Block/Allow Video:
Choose whether to block or allow your video to be visible to other participants, offering flexibility and privacy during the meeting.

Emoji Reaction:
Express yourself non-verbally with emoji reactions, allowing for quick feedback and engagement with the discussion without interrupting the flow of conversation.

Screen Sharing:
Share your screen with other participants to present slides, documents visual communication.

Record Meeting:
Capture the entire meeting, including audio, video, and screen sharing, for future reference or sharing with absent participants.

Disable:
Disable specific features or permissions as needed, such as disabling chat or screen sharing, to maintain control over the meeting environment and ensure security and productivity.

See Number of Participants:
Quickly view the number of participants in the meeting, providing valuable context and awareness of the audience size. These features available and many others features are available to actively engage in the meeting, Fig.10.Features available after joining the meeting.
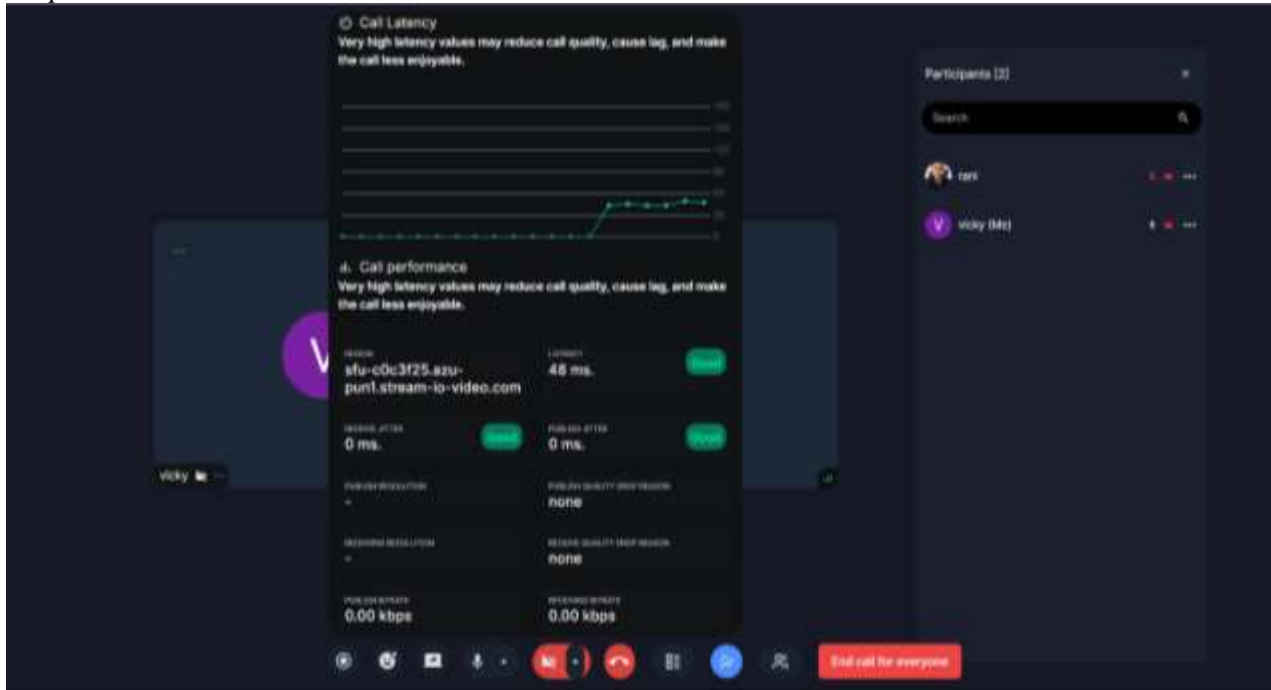
Unique Feature In Our Yoom

Fig.11:-Advance feature in our yoom.

1. Call Latency Tracking: YOOM continuously monitors the latency of each call, measuring the time it takes for data to travel from the sender to the receiver and vice versa. Users can view real-time metrics indicating the latency of their audio and video streams, ensuring smooth and uninterrupted communication. Latency measurements are displayed graphically or numerically, allowing users to quickly identify any issues and take corrective action as needed to optimize performance.
2. Call Performance Analysis: YOOM analyzes various factors affecting call performance, including network stability, bandwidth availability, and device performance. Users receive comprehensive reports detailing the overall call performance, including metrics such as jitter, packet loss, and throughput. These insights enable users to diagnose and troubleshoot issues impacting call quality, empowering them to make informed decisions to enhance their communication experience.

Benefits:
1. Improved Communication Quality: By tracking call latency and performance, users can identify and address issues that may degrade the quality of their calls, ensuring a seamless and enjoyable communication experience.
2. impactive Issue Resolution: YOOM's real-time monitoring and analysis enable users to proactively identify and resolve performance issues before they impact productivity or user satisfaction.
3. Data-Driven Decision Making: With access to detailed performance metrics and analytics, users can make informed decisions to optimize their network configuration, device settings, and communication protocols for optimal performance.

Overall, YOOM's call latency tracking and performance analysis feature empowers users to maintain high-quality communication and collaboration, facilitating productive and efficient interactions in any scenario, Fig.11.Advance feature in our yoom.

Responsive Design
The YOOM Meeting platform boasts a responsive design that seamlessly adapts to various screen sizes and devices, ensuring an optimal user experience across desktops, laptops, tablets, and smartphones. Through flexible layout adjustments and fluid content scaling, users can navigate meetings, access features, and engage with content effortlessly, regardless of their preferred device or viewing environment, Fig.12 Responsive design.
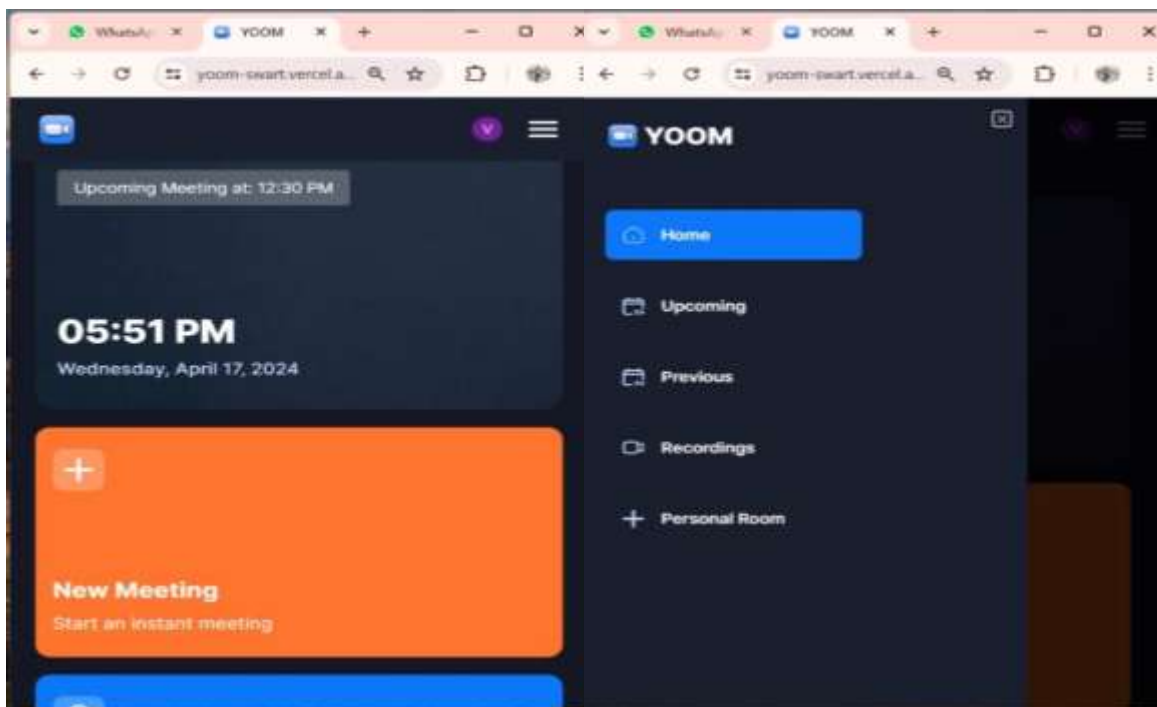
Fig.12:-Responsive design.

Conclusion

The development and implementation of our virtual meeting platform mark a significant milestone in the realm of digital collaboration and communication. Through meticulous planning, iterative development, and user-centered design, we have created a versatile and feature-rich platform that addresses the evolving needs of modern workplaces and remote teams. Our journey began with a vision to revolutionize virtual collaboration and communication, and we are proud to say that we have successfully realized that vision. By incorporating a comprehensive set of features, including authentication and authorization, meeting management, participant controls, and security measures, we have created a platform that empowers users to conduct productive and engaging meetings with confidence. Central to our approach was a commitment to user-centric design. The development and implementation of our virtual meeting platform signify a transformative leap in digital collaboration. Through a meticulous approach blending user-centered design with advanced technologies like Next.js, Tailwind CSS, TypeScript, Clerk, Get Stream, and Shadcn, we have crafted a versatile platform meeting the evolving needs of modern workplaces and remote teams. Our platform stands out for its comprehensive feature set, intuitive design, and robust security measures, empowering users to conduct productive meetings with confidence. The positive user feedback underscores our success in delivering an intuitive, efficient, and secure platform. Looking ahead, we remain committed to continuous improvement, focusing on accessibility, performance optimization, and scalability to ensure a seamless experience for all users. As we continue to push boundaries and innovate, we are excited about the possibilities and the impact we can make in the realm of virtual collaboration. In conclusion, the development of our virtual meeting platform represents a significant achievement, showcasing the power of innovation, collaboration, and user-centered design. As we look back on our journey, we are filled with pride and gratitude for the opportunity to make a meaningful impact in the world of virtual collaboration.

Authors

First Author and the other authors may include biographies at the end of regular papers. In this section authors can included their studies number of publications they have and any achievements the authors have obtained. All the authors can included their photos as well as biographies, if they wish.

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