

Automated Group Discussion Feedback and Scoring with AI

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Abstract

In traditional group discussions, the absence of a human moderator can lead to issues such as dominance by certain individuals, lack of adherence to discussion rules, and insufficient feedback for participants. To address these challenges, an AI-driven group discussion platform is being developed to ensure structured, fair, and productive interactions. The platform will monitor discussions via video, using machine learning to analyze participants' behavior and adherence to ethical guidelines. AI will provide real-time guidance and personalized feedback, assessing individual contributions to highlight strengths and areas for improvement. Comprehensive reports will be generated for each participant, tracking their progress over time. The platform will support two modes: a random call discussion mode for spontaneous interactions and a dedicated college mode for student discussions within an academic context. Timed sessions will ensure focused and efficient discussions. By integrating continuous assessment and rewarding active participation, the platform aims to enhance communication skills, promote ethical behavior, and foster a collaborative learning environment.

Keywords: Real-time monitoring, Behavior analysis, Ethical guidelines, Personalized feedback, Structured interactions, Participant engagement, Academic discussions.

1. Introduction

Group discussions are a crucial aspect of both educational and professional environments, fostering collaborative learning, critical thinking, and effective communication skills. However, the absence of a human moderator in these discussions often leads to several challenges. Dominance by certain individuals can overshadow the contributions of quieter participants, leading to an imbalance in the discussion. Additionally, without proper moderation, discussions can deviate from their intended focus, and participants may fail to adhere to established rules and ethical guidelines. This lack of structure and feedback can impede the overall effectiveness of the discussion and hinder the personal growth of the participants. To address these challenges, this project proposes the development of an AI-driven group discussion platform. This innovative platform leverages artificial intelligence and machine learning

technologies to monitor and analyze video discussions in real-time. By observing participant behavior and ensuring adherence to ethical guidelines, the platform aims to create a more balanced and productive discussion environment. One of the key features of the platform is its ability to provide real-time guidance and personalized feedback to participants. This feedback highlights individual strengths and areas for improvement, encouraging participants to refine their communication skills and engage more effectively in discussions. The platform generates comprehensive reports for each participant, tracking their progress, contributions, and behavior over time. This continuous assessment ensures that participants receive ongoing support and recognition for their efforts. The platform supports two distinct modes of operation: a random call discussion mode and a

dedicated academic mode. The random call discussion mode facilitates spontaneous interactions, allowing participants to engage in discussions with diverse groups of people. In contrast, the academic mode is designed for structured student discussions within an educational context. Both modes incorporate timed sessions to ensure that discussions remain focused and efficient. By integrating AI-driven monitoring, personalized feedback, and continuous assessment, the platform addresses the inherent challenges of unmoderated group discussions. It promotes a more structured and ethical discussion environment, enhancing communication skills and fostering a collaborative learning culture. The use of machine learning algorithms to analyze video feeds and detect behavioral cues further enriches the platform's ability to provide insightful feedback and comprehensive analysis. In summary, this AI-driven group discussion platform aims to revolutionize the way group discussions are conducted. By ensuring fair and productive interactions, providing real-time feedback, and supporting both spontaneous and structured discussions, the platform seeks to enhance the overall effectiveness of group discussions and contribute to the personal and professional growth of participants.

2. Literature Review

The advancement of AI-driven discussion analysis has led to significant improvements in online learning environments. Automated Discussion Analysis (ADA) frameworks provide a structured approach to managing knowledge from class discussions, enhancing critical thinking and analyzing learning behaviors effectively [1]. The integration of machine learning techniques in online education has further optimized knowledge assessment, as seen in models that classify discussion questions based on cognitive levels and learning objectives, improving engagement and personalized learning experiences [11]. Similarly, research on student learning outcomes has leveraged machine learning algorithms like Decision Trees and Naïve Bayes to measure educational impact and improve evaluation techniques [6]. AI-powered conversational agents have also evolved, contributing to enhanced human-agent collaboration

through advancements in natural language processing and machine learning [4]. This integration has significantly improved intelligent virtual assistants, optimizing decision-making and predictive capabilities across industries, including education [9]. In the context of knowledge analysis, AI-driven enterprise dialogue systems such as KNADIA have incorporated deep learning and knowledge graphs to enhance customer interactions, demonstrating high response accuracy and contextual understanding [10]. The role of AI in analyzing large-scale learner data in MOOCs has also been explored, with studies showing strong correlations between engagement, motivation, and performance, leading to data-driven course enhancements [14]. Machine learning's application in online discussions extends to the study of grouping strategies, where social network analysis has revealed that diverse groups foster deeper engagement and knowledge sharing, ultimately improving collaboration [8]. Research on online teaching during the COVID-19 pandemic has identified effective digital strategies, highlighting challenges such as unequal access while proposing frameworks for improved online education [7]. Another critical aspect of AI in education is adversarial machine learning in text processing, which identifies security vulnerabilities in NLP models and explores countermeasures to enhance robustness and reliability [3]. With the increasing demand for effective communication, videoconferencing technologies have been extensively analyzed to enhance user experiences. A comparative study on Zoom, Webex, and Google Meet has revealed performance differences based on bandwidth, device status, and geographic resource allocation [5]. To improve videoconferencing scalability, the SWITCH-ing project has proposed an event-driven architecture, optimizing resource allocation and improving environmental sustainability [12]. Software-defined networking (SDN) has also been explored as a solution for enhancing multi-party video conferencing by improving multicast routing and reducing latency [13]. Additionally, peer-to-peer multipoint video conferencing utilizing layered video coding has been introduced to optimize video quality across

heterogeneous networks, reducing reliance on centralized servers [15]. Finally, a machine learning-based approach for mitigating co-tier interference in 5G heterogeneous networks (HetNets) has been developed, addressing video delivery challenges through classification and offloading mechanisms, significantly improving throughput and reducing packet loss [2]. Collectively, these studies demonstrate how AI, machine learning, and intelligent technologies are transforming knowledge analysis, online discussions, and video-based communication, contributing to more efficient, interactive, and intelligent learning environments.

3. Proposed System

This AI-driven online discussion and video communication platform enhances interactive discussions through advanced machine learning, real-time behavioral analysis, and gamification techniques. Unlike traditional systems, it integrates NLP-based semantic analysis, sentiment detection, and video-based behavior recognition to assess participant engagement, communication effectiveness, and adherence to ethical guidelines. Deep learning models analyze speech and facial expressions, enabling real-time monitoring of discussion dynamics and emotional intelligence. Automated feedback highlights areas for improvement in communication skills, critical thinking, and collaboration. A gamification module introduces elements such as badges, leaderboards, and achievement levels to boost user participation and motivation. An AI-powered scoring mechanism evaluates participant contributions based on relevance, coherence, and ethical considerations, ensuring structured and meaningful discussions. Adaptive bandwidth optimization techniques enhance video communication by improving resource allocation and minimizing network latency. Secure encryption protocols and privacy-preserving AI techniques safeguard user data while maintaining transparency in assessments. Additionally, the system includes an automatic report generation feature that compiles discussion insights, participant performance metrics, and behavioral trends into structured reports for educators, facilitators, or organizations. These reports help in evaluating user

progress and decision-making for future discussions. Automated summarization and insight generation further enhance knowledge evaluation, enabling facilitators to derive meaningful discussion trends. By incorporating multimodal AI analysis, gamification, and real-time feedback mechanisms, this system transforms online discussions into a more interactive, insightful, and ethically guided experience (Table 1).

3.1 Key Features

- **Real-Time Behavioral Analysis:** Monitors engagement and ethical adherence.
- **AI-Powered Scoring:** Evaluates discussion relevance and effectiveness.
- **Sentiment & Facial Expression Recognition:** Enhances emotional intelligence insights.
- **Gamification Elements:** Badges, leaderboards, and achievements for motivation.
- **Automatic Report Generation:** Generates structured insights and performance metrics.
- **Bandwidth Optimization:** Improves video quality and reduces latency.
- **Privacy & Security Measures:** Ensures data encryption and ethical AI compliance.
- **Automated Summarization:** Extracts key discussion insights efficiently.

Table 1 AI-Driven Participant Behavior Analysis and Engagement Metrics

Categ ory	Metrics Analyzed	Purpose	AI Utilization
Behavi or Analys is	Speech clarity, confidence, participation level	Assess communica tion skills	NLP-based sentiment & tone analysis
Pattern s	Speaking duration, interruptions, engagement trends	Identify dominant vs passive participants	Machine learning pattern recognition
Report s	Performance summaries, ethical	Track progress and provide	AI- generated reports with

	adherence, feedback	structured insights	improvement tips
Gamification	Points, leaderboards, badges, role-based challenges	Encourage participation and learning	AI-driven challenges & adaptive rewards
Assigned Topics	Topic relevance, depth of discussion, adherence to theme	Ensure meaningful and structured discussions	AI-assisted topic assignment & evaluation

4. Methodology

The AI-driven online discussion and video communication platform follows a structured methodology, incorporating advanced technologies such as machine learning, natural language processing (NLP), and real-time video analytics. The system is designed to enhance engagement, monitor discussions, and provide insightful feedback for participants and facilitators.

4.1 Data Collection and Preprocessing

The system collects video, audio, and text data from live discussions. Preprocessing techniques such as noise reduction, speech-to-text conversion, and facial feature extraction are applied to refine the collected data. NLP techniques process textual content to improve semantic understanding, ensuring accurate behavioral insights. The data is then structured for further analysis by AI models.

4.2 Machine Learning and Deep Learning Implementation

Machine learning and deep learning models are used to analyze various aspects of participant behavior. Speech patterns, facial expressions, and engagement levels are processed using deep learning algorithms. NLP-based sentiment analysis and contextual relevance detection ensure meaningful contributions. Classification models are trained on structured discussion datasets to automate ethical adherence scoring and behavioral tracking.

4.3 Gamification Module Development

To enhance user motivation and active participation, a gamification system is integrated. Features such as

leaderboards, achievement badges, and dynamic scoring mechanisms encourage ethical behavior and engagement. AI-powered scoring rewards users based on their contribution quality, speech clarity, and adherence to discussion guidelines. Personalized feedback helps participants improve their communication skills.

4.4 Real-Time Monitoring and Feedback System

The platform incorporates real-time video analytics to track gestures, expressions, and speech clarity. AI-driven monitoring assesses participant behavior and generates automated feedback. Sentiment detection provides an analysis of discussion tone and engagement levels, ensuring fair and productive discussions. Alerts are triggered for facilitators when discussions deviate from ethical norms.

4.5 Automatic Report Generation

AI algorithms compile structured reports on participant performance, discussion insights, and behavioral trends. These reports include metrics such as engagement levels, sentiment analysis, and adherence to discussion guidelines. Automated summarization techniques enhance report clarity, while data visualization tools present key findings for educators and discussion moderators.

4.6 System Optimization and Deployment

The system undergoes iterative testing and optimization to ensure efficient performance. Adaptive bandwidth management techniques improve video streaming quality, even in low-network conditions. Security measures, including data encryption and privacy protocols, are implemented to protect user information. Once refined, the system is deployed, ensuring a seamless and interactive online discussion experience.

5. Implementation

5.1 User Authentication and Access Control

The system ensures a secure and seamless authentication process for different user roles, including administrators, facilitators, and participants. Role-Based Access Control (RBAC) ensures that each user has appropriate permissions, preventing unauthorized data access. The authentication mechanism is built using JSON Web Tokens (JWT) for secure session management, and passwords are encrypted using bcrypt hashing. The

frontend, developed with ReactJS, provides an interactive and responsive login and registration interface, while user credentials and profiles are securely stored in MongoDB, ensuring data integrity. Additionally, OAuth 2.0 authentication can be integrated for third-party login options, such as Google and Microsoft authentication (Figure 1).

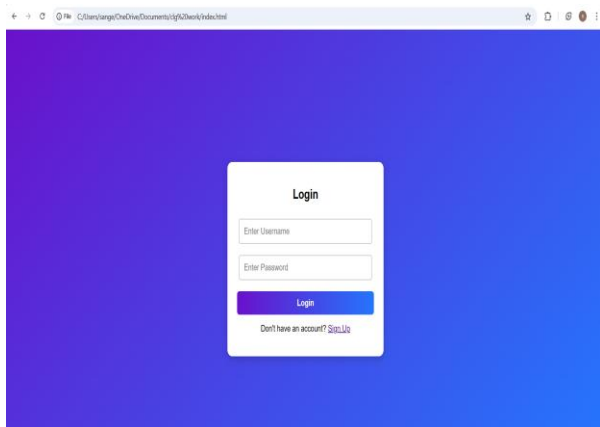


Figure 1 Login page

5.2 Dashboard and Navigation

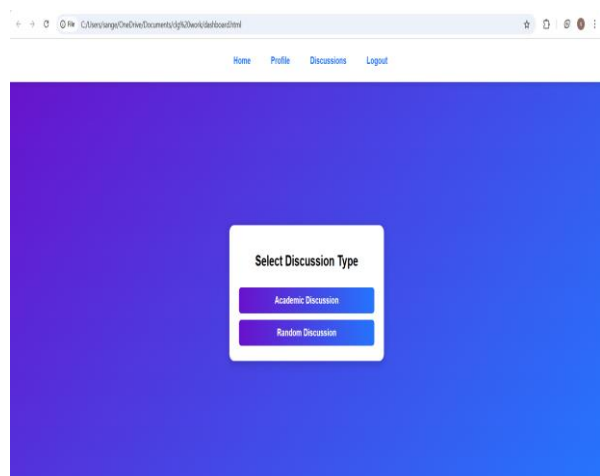


Figure 2 Dashboard

The dashboard serves as the central hub where users can view discussion topics, monitor engagement, and access system features. Built with ReactJS, the interface is designed to be intuitive and user-friendly, with dynamic updates using Redux for state management. The backend, developed with Node.js and Express.js, ensures smooth data retrieval and processing. Interactive visual elements, powered by

Chart.js, provide real-time insights into user activity, participation trends, and discussion analytics. The navigation system allows seamless transitions between different features, improving user experience and accessibility (Figure 2).

5.3 Automated Topic Assignment Using AI

The system leverages Natural Language Processing (NLP) to dynamically assign discussion topics based on participants' past engagement, interests, and expertise levels. Latent Dirichlet Allocation (LDA) and TF-IDF (Term Frequency-Inverse Document Frequency) models categorize topics, ensuring relevance and variety. The backend, powered by Node.js and Python, processes user profiles and discussion history, enabling AI-driven recommendations. This ensures that topics are assigned fairly while adapting to changing trends and participant preferences (Figure 3).

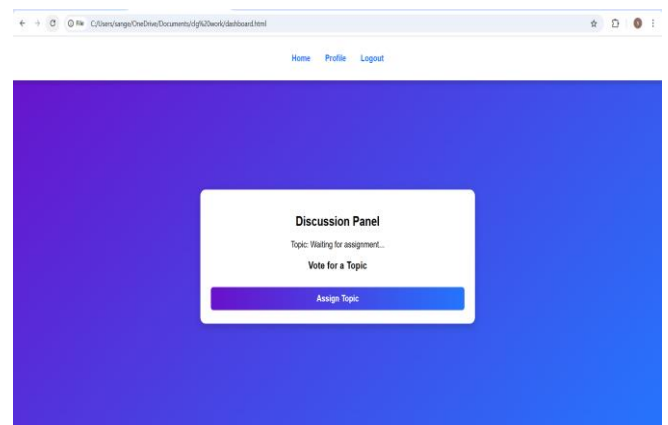


Figure 3 Automated Topic Assignment

5.4 AI-Powered Video Analysis and Monitoring

The system employs TensorFlow and OpenCV for real-time video analysis, tracking participants' facial expressions, eye movement, and speech tone to assess engagement levels. Convolutional Neural Networks (CNNs) process video frames to detect emotions such as attentiveness, confusion, or disengagement. Speech recognition models built with DeepSpeech analyze tone variations and clarity. Real-time video streaming is powered by WebRTC, ensuring low-latency analysis and smooth communication. These AI-driven insights help facilitators evaluate participants' engagement and identify areas for improvement (Figure 4).

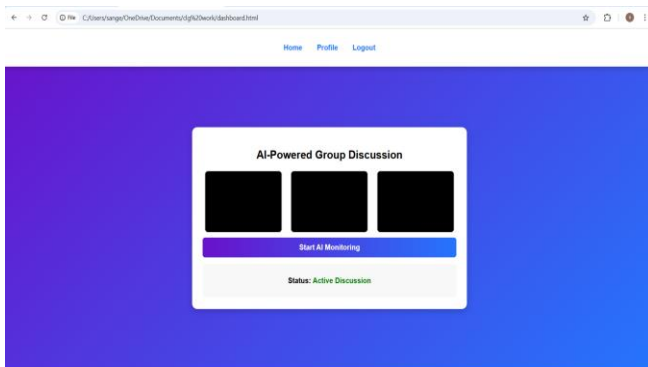


Figure 4 AI-Powered Video Analysis and Monitoring

5.5 Gamification and Engagement Strategies

Gamification elements are integrated to enhance user engagement through leaderboards, badges, and performance-based challenges. AI-driven scoring mechanisms evaluate participation based on factors such as speaking time, engagement level, and adherence to discussion ethics. Reinforcement learning algorithms dynamically adjust engagement strategies, optimizing user motivation. The ReactJS frontend updates leaderboards in real time, while engagement metrics are stored in MongoDB for historical tracking. This approach encourages active participation and fosters a competitive yet collaborative environment (Figure 5).

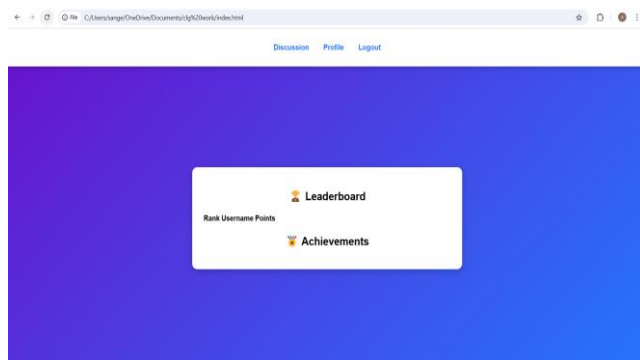


Figure 5 Gamification

5.6 Automated Report Generation and Performance Analytics

The system generates AI-driven performance reports that analyze participants' speaking frequency, discussion contribution, and behavioral trends. Machine learning models assess discussion patterns, providing personalized feedback and improvement

suggestions. Reports include graphical insights powered by D3.js, allowing users to track progress over time. The reporting module supports PDF and CSV export options, ensuring easy data sharing. Reports are securely stored in AWS S3, Azure Blob Storage, or Google Cloud Storage, ensuring accessibility and security (Figure 6).

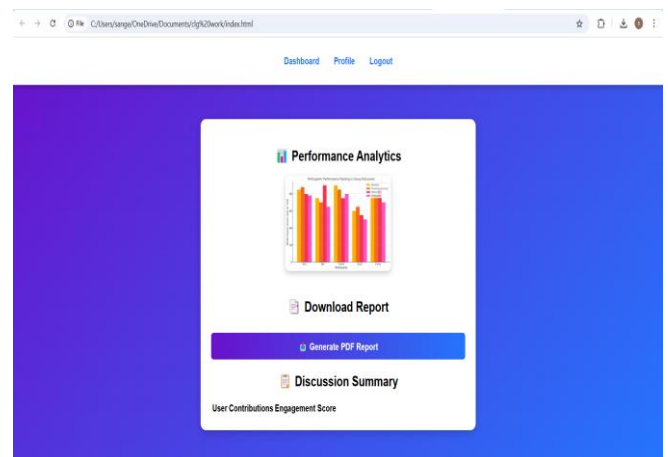


Figure 6 Report Generation

5.7 Real-Time Notifications and Alerts

The notification system ensures timely updates through automated email, SMS, and in-app alerts. Twilio API handles SMS notifications, while SendGrid or AWS SES (Simple Email Service) manages email alerts. These notifications inform users about upcoming discussions, performance reports, and system updates. WebSockets (Socket.io) enables real-time push notifications within the web application, enhancing communication and engagement (Figure 7).

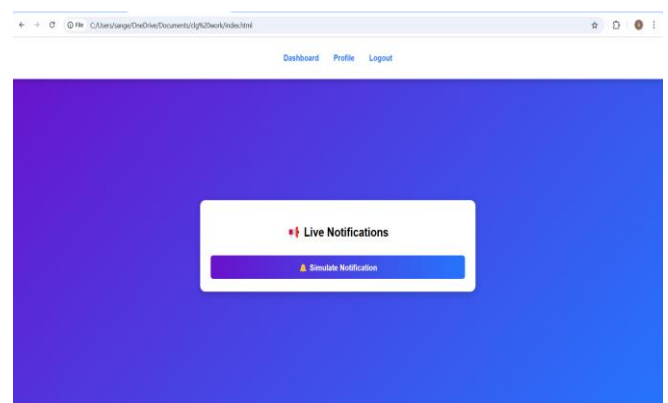


Figure 7 Notification

5.8 Cloud Storage and Data Security

All user data, video recordings, and analytics are securely stored on cloud platforms such as AWS, Azure, or Google Cloud. End-to-end encryption (AES-256 and TLS 1.2) ensures that sensitive data remains protected. MongoDB Atlas is used for cloud-based database management, providing scalability and reliability. Docker containerization ensures seamless deployment, while Kubernetes manages cloud resources efficiently. Regular security audits and compliance checks ensure adherence to GDPR and ISO 27001 standards.

5.9 Live Discussion Monitoring and Compliance

The system continuously monitors discussions for ethical adherence and engagement patterns. AI-driven speech-to-text conversion using Google Speech API and IBM Watson Speech-to-Text enables real-time transcription and sentiment analysis. Natural Language Processing (NLP)

models flag inappropriate language, ensuring discussions remain respectful. Facial recognition models detect attention levels, ensuring productive discussions. The system also incorporates Bias Detection Algorithms, preventing biased speech patterns and ensuring fair participation.

5.10 Data Privacy and Security Mechanisms

To safeguard user privacy, the system implements zero-trust security protocols, ensuring that all access is strictly monitored. OAuth 2.0 authentication secures API access, preventing unauthorized interventions. Role-Based Encryption (RBE) ensures that sensitive data is accessible only to authorized personnel. Regular vulnerability assessments and penetration testing are conducted to maintain high-security standards. Compliance with GDPR, HIPAA, and ISO 27001 guarantees that user data remains secure and private (Figure 8).

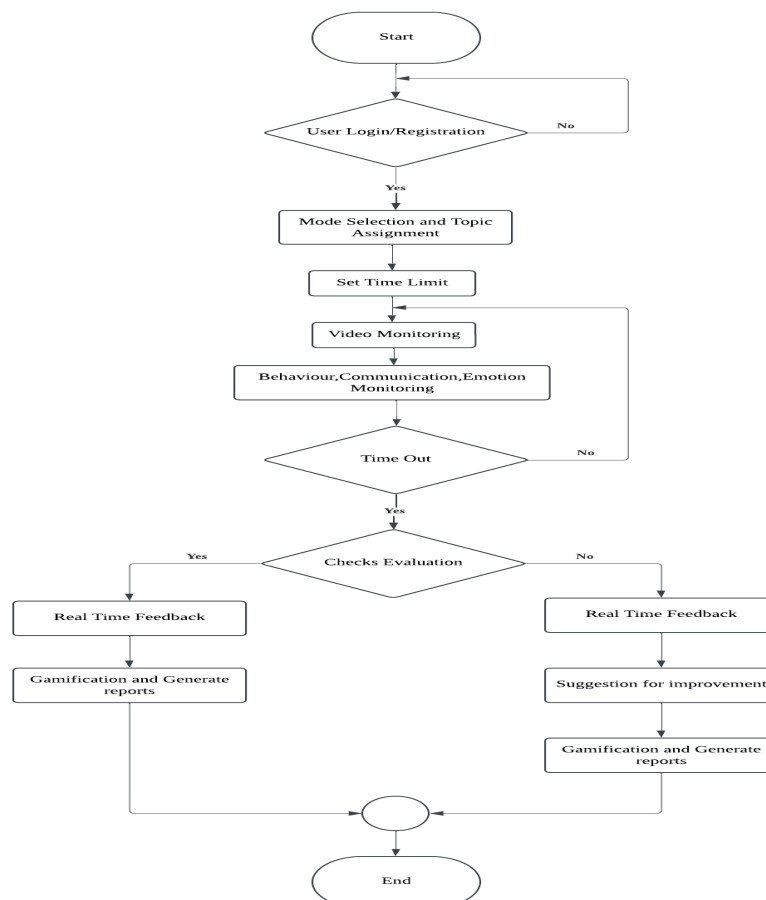


Figure 8 Flow Chart

Conclusion

The AI-driven group discussion platform has significantly enhanced communication skills, engagement, and learning outcomes. The real-time AI feedback system ensures that participants receive personalized guidance, helping them articulate their thoughts more effectively. By analyzing speech patterns, participation levels, and argument structures, the AI encourages balanced discussions, reducing dominance and improving inclusivity. The gamification mechanics, including AI-driven challenges and leaderboards, have fostered a competitive yet collaborative environment, motivating participants to refine their clarity, confidence, and critical thinking. The adaptive learning model ensures that feedback evolves based on discussion trends, helping users progressively improve their speaking and reasoning abilities. Additionally, the automated performance reports provide detailed insights into individual speaking time, engagement level, and adherence to ethical guidelines. This feature has proven highly beneficial in educational and professional settings, helping users track and enhance their communication skills over time.

Future Enhancement

The platform will introduce AI-powered speech coaching to improve tone, clarity, and delivery, along with emotion and sentiment analysis to adapt guidance based on confidence and engagement levels. Personalized AI avatars will provide real-time feedback on gestures and voice modulation, making discussions more interactive. A hybrid human-AI moderation system will enhance discussion quality, while blockchain-based certification will offer verifiable records of communication improvements. AR collaboration tools will visualize speaker influence and engagement trends in real time. Additionally, neuroscientific AI insights will optimize discussion structures, and role-specific training modules will cater to leadership, debates, and professional speaking, ensuring tailored learning experiences for all participants.

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