

REAL-TIME COLLABORATIVE WHITEBOARD

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ABSTRACT

This line of research work outlines the formulation of a Real-time Collaborative Whiteboard solution whereby one can draw, communicate and collaborate in realtime via a web-based space and multiple users are involved. The system combines WebRTC to communicate via voice in a peer-to-peer fashion, Socket.IO to synchronize the drawing data in almost real-time event-based processing and MongoDB to maintain a lasting storage place. It will offer functionality as multiuser drawing, live cursor tracking, undo/redo, role-based user administration, and intelligent content summary. The platform is well tailored to educational and professional use-cases where collaborative brainstorming and real-time collaboration is needed in addition to screen sharing. The system has been evaluated experimentally and has shown to provide low-latency, scalability across multiple users and enhanced interaction with respect to

collaborative activities. The offered solution is characterized by the opportunities of contemporary web technologies and artificial intelligence which should become the powerful collaboration tool that will be accessible, reliable, and user-friendly.

KEYWORDS: *Real-time Collaboration, Whiteboard, WebRTC, Socket.IO, Multiuser Systems, Educational Technology, AI Summarization, Web-based Drawing.*

INTRODUCTION

The frenzied virtuality of collaborative work and distance learning has resulted in greater demands in terms of productive tools of real-time collaboration. The traditional conferencing systems are more likely to provide the screen sharing communicate, solve a problem jointly, and engage in brainstorming. This deficiency has caused the need to have an efficient and friendly collaborative whiteboard system that would enable drawing and

communication between different parties in real time. Real-time Collaborative Whiteboard is the platform that can help to eliminate this issue because the former uses different modern web technologies in a single framework. The availability of the features, such as the live tracking of the cursor, undo/redo capabilities, and the AI based summarization, allows it to be an effective tool at education establishments and half-professional units. By use of WebRTC during the voice communication, Socket.IO during the synchronization and MongoDB during storage, the system offered results in a low latency, reliable and scalable system. It provides an elastic platform where the employees can collaborate with one another regardless of their work locations.

LITERATURE SURVEY

Rise of work in concert Working together digitally Early collaborative work can be traced to the early computer-supported cooperative work (CSCW) systems to more recent web and network-based systems. Ellis et al., pointed out the importance of shared workspace and real time awareness of groupware systems that are the foundation of the existing collaboration tools. With the shift to online resources in the sector, the former encounters the issue of availability and fit

to cross-devices. Browser communication WebRTC or other Internet real-time communication technology has transformed the use of the browser as a communication medium by enabling peer-to-peer audio and video to be transferred by allowing no third-party plugins or protocols to be needed. Johnston et al. revealed that WebRTC can present low latency application; hence, it can benefit in collaborative whiteboards. Similarly, Socket.IO was adopted as a commonly used formation of two-way communications with guarantee of synchronization considering an unstable network. The research on collaborative drawing systems have addressed the issues of consistency, conflict resolution, user-friendly, etc. Sun and Ellis proposed operation transformation of group editors and Ignat and Norrie proposed parallel-edit resolution models. Contemporary real-time synchronization algorithms rely on this methodology.

EXISTING WORK

It has a few commercial and academic versions of collaborative whiteboard already available in the market with a mixed range of benefits and constraints. The advantages of the available popular commercial platforms currently accessible (Miro, Figma, and Microsoft Whiteboard)

might involve the possibility of powerful collaborative features, however, the general description could be outlined with such drawbacks as the high level of latency, insufficient palette of customization and use due to subscription. Even better, the majority of the tools would be proprietary requiring exclusive data formats, thus limiting their capabilities to interoperate and flexibility to systems that do not necessitate self hosting or open systems. The academic research has also considered various tactics on the collaborative drawing systems. Sketching, shared meeting spaces The Group Sketch and Tivoli, early examples of multi-user sketching, share a meeting environment; conversely, projects like DOLPHIN enabled cooperative hypermedia authoring. However, they were bound by the technological hardware and software of that time and making them irrelevant in the current day with the outline of a large scale, web-based collaboration. In addition to that, there are several opensource software, few of them being Exalites and Open Board Parallelism.

PROPOSED SYSTEM

The given Real-time Collaborative Whiteboard will be envisaged as a drawing and real-time communication platform in

terms of which a set of modern web-based technologies will be combined so that to realize a possibility to communicate conveniently with one another in case of multiple users. The architecture of the system is built on the client-server basis, and includes drawing functions, real-time ones, including persistent back-end storage, with text and images, and AI-based content analysis. The client-based solution is composed with HTML5 Canvas to draw on the client side, Socket.IO to coordinate drawing with peers in real-time and WebRTC to deliver voice messages. The interface will be responsive, thus be reachable to desktops, laptops and mobile devices. Pen, eraser and shape tools can be used with the user and features live cursor tracking, color choice, undo/redo. The process of drawing is achieved with the help of Node.js and Express, which are referred to as the back-end framework that provides the API requests and messaging about the events. Mogo DB is set up in which data on drawing, session history and user details is stored. The administrators can then control the room, monitor activities and control permissions by providing security access and the assigned access privileges on a role based user management capability. An audio WebRTC-enabled form of communication

facilitates communication of peers and users can chat in real-time through a WebRTC-based layer of communication. To accomplish the low latency drawing synchronization, Socket.IO is utilized and REST APIs are used to execute the authentication and the data persistence. Gemini API integration is also an interesting enhancement in this system where Google API driven AI based content summarization is performed. This allows the features to analyze the white board contents in generating summaries and highlights automatically used in work rooms, group meetings and brainstorming sessions. The low latency, scalability, and security considerations have been applied to the construction of the system. The Realtime collaborative whiteboard offers a complete interactive resource to cooperate at school and in the workplace through the feature of drawing, communication, modern smart analytics of content.

METHODOLOGY

The Real-time Collaborative Whiteboard, was designed based on the iterative-agile method to make sure it is always improved and integrated with functions. The architecture of the system consists of various levels each of which processes one of the main features. Data flow of the drawing begins with interactions of the

user with the canvas that captures the coordinates and transmits them to the server through Socket.IO. The server then sends these changes to any other clients in the same session so that changes appear in real time to all clients. This synchronization can be down to sub-100ms latency and hence the user experience is fluent. When it comes to voice communication WebRTC is introduced to connect peers to each other. The microphone input is recorded, coded and transmitted to other users that capture minimum delay and maintain the clarity. This kind of combination allows the users to communicate as they used to when in the typical whiteboard. The MongoDB offers data persistence to which the drawing operations and the session-history are reserved. This enables the automatic saving of content, tracking of versions using undo/redo and re-loading past sessions at demand. Indexed queries and fast optimization of database functions justify a high access speed in a case, when a number of other users are simultaneously working on their queries. The role-based access control is provided in the user management system. The users must sign-in and log-in to rooms. Administrators can get an opportunity to make rooms, allocate rights and monitor the activity of the users.

Passwords are hashed.

EXPERIMENTAL RESULTS

In order to test scalability, the platform could be tested with as many as 50 parallel users. The server managed to draw and use at the same time without significant performance losses. User feedback from educators and professional teams confirmed the system's effectiveness. Educators reported increased student engagement, while professional teams found brainstorming sessions more productive. The integration of AI-powered summarization was particularly appreciated, as shown in Figure 1, where the system automatically generates concise summaries of collaborative content. Another strong feature of the system was administrative control. The Admin Panel (Figure 2) has room management, user access control, activity being tracked features and hence secure and organized collaboration. Also, the system gives the functionality to edit the images directly on the canvas. of the whiteboard. Users can import, resize and annotate images in live sessions through this. Figure 3 demonstrates such capability when editing functions in the image are presented on the board.

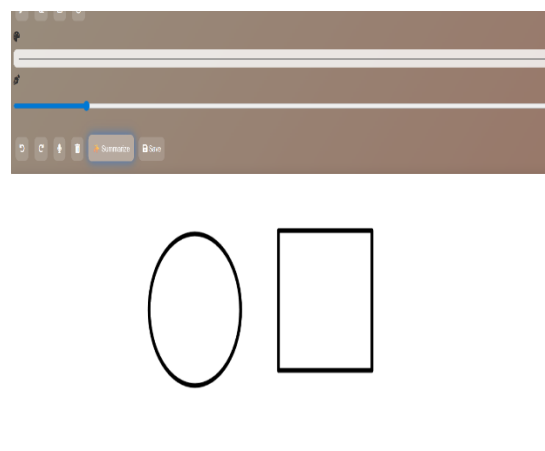


Fig. 1. AI summarize

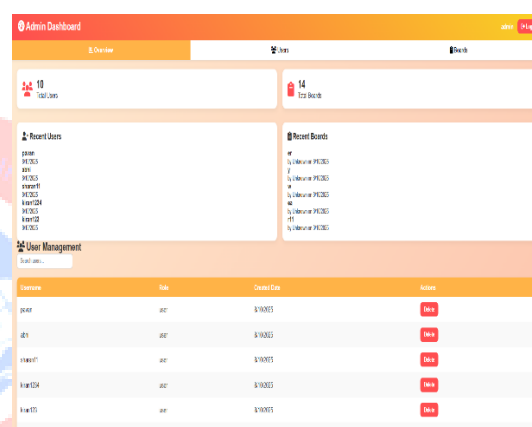


Fig. 2. Admin controls



Fig. 3. Image editing on whiteboard

CONCLUSION

The aim of this research was to come up with the Real-time Collaborative Whiteboard platform that allows having multiple users drawing, communicating, and collaborating in real-time. The system has incorporated many new technologies, including Socket.IO to synchronize, WebRTC to use voice communication, and MongoDB to have persistent storage; thus, its use overcomes the constraints of other readily available tools. Such aspects as cursor tracking and live movement tracking, undo/redo functions, role-based user management, and the usage of AI based content summarization can make this platform more flexible and efficient than the existing ones. As measured in the experimental performance, it was shown that the system can execute with minimal latency, can scale-up to support tens of users simultaneously, and can be used in interesting and engaging learning and professional applicative scenarios. The practicality and usefulness of the system in the real-life collaboration is further supported by positive feedback given by the users

REFERENCES

- [1] C. A. Ellis, S. J. Gibbs, and G. L. Rein, "Groupware: Some issues and experiences," *Communications of the ACM*, vol. 34, no. 1, pp. 38–58, 1991.
- [2] A. B. Johnston, D. C. Burnett, and A. Bergkvist, *WebRTC: APIs and RTCWEB Protocols of the HTML5 Real-Time Web*, Digital Codex LLC, 2012.
- [3] C. Sun and C. Ellis, "Operational transformation in real-time group editors: issues and models," *Proceedings of the 1998 ACM Conference on Computer Supported Cooperative Work*, pp. 59– 68, 1998.
- [4] C. L. Ignat and M. C. Norrie, "Operation-based conflict resolution for real-time collaborative editing," *Proceedings of the 2003 International ACM SIGGROUP Conference on Supporting Group Work*, pp. 213–222, 2003.