

**Summary of the research paper as an outcome of PBL-II project**

**ON**

**“COLLABIO: Collaboration Made Easy”**

Submitted in partial fulfillment of the requirements for the degree of

BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE & ENGINEERING

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**Symbiosis Institute of Technology, Pune**

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## **CERTIFICATE**

This is to certify that the PBL-II Project work entitled “COLLABIO: Collaboration Made Easy” is carried out by Manya Lamba and Nakul Kushwaha, in partial fulfillment for the award of the degree of Bachelor of Technology in Computer Science & Engineering, Symbiosis Institute of Technology Pune, Symbiosis International (Deemed University) Pune, India during the academic year 2024-2025.

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Name & Signature of Co-Guide

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Name & Signature of Guide

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## **Problem statement of the project**

Today's virtual meeting platforms like video conferencing tools lack the natural flow and engagement of face-to-face meetings, users are stuck in fixed video grids which feels stiff and impersonal. Other avatar-based platforms often have cluttered game-like interfaces that don't suit professional needs, while some require costly VR hardware making them hard to access for many. Specific issues include rigid meeting setups that block spontaneous chats, no spatial context for interactions, weak collaboration tools beyond screen sharing, complex designs that distract, and hardware barriers that limit use. There's a clear need for a browser-based solution that mixes dynamic features like proximity-based video calls and real-time collaboration with a clean professional interface. Collabio aims to solve this by creating a 2D virtual space where users move avatars to start natural conversations, draw together on a whiteboard, and chat globally all without special hardware. This approach seeks to boost engagement, accessibility, and usability, making teamwork more effective and enjoyable for remote teams, students, and social groups.

## **Abstract of the Paper**

Collabio is a 2D virtual collaboration platform designed to fix gaps in current virtual meeting tools which often miss the spontaneity and engagement of in-person interactions. Developed by Manya Lamba and Nakul Kushwaha for a B.Tech at Symbiosis Institute of Technology Pune in 2024-25 under Prof Ranjeet Bidwe's guidance, it offers a gamified space where users navigate avatars, trigger video calls by moving close, draw on a shared whiteboard, and use global chat. Built with React.js, WebRTC, Socket.io, and Tldraw, Collabio is a lightweight browser-based tool needing no special hardware unlike VR-based platforms. It overcomes rigid grids of traditional video calls and cluttered designs of avatar-based tools, providing a clean professional interface. The report details Collabio's goals to enhance engagement, enable natural communication, and integrate real-time collaboration tools. It covers the agile development process, client-server architecture, and testing, which showed fast video calls (80ms), smooth avatar movement (60 FPS), and reliable whiteboard sync (450ms). User feedback from 10 testers praised its ease and natural feel, though mobile support needs work. Challenges like WebRTC setup were solved with optimization. Collabio offers a scalable, engaging alternative to existing platforms with potential for mobile apps and AI features. It redefines virtual teamwork for schools, businesses, and social groups, balancing fun and productivity.

## **Summary of the Literature Review**

We reviewed seven articles to guide Collabio's development, sourced from academic databases like ResearchGate, Academia.edu, and journals such as Electronics and Computers & Education. The review focused on virtual collaboration tech, covering WebRTC for real-time communication, gamified environments with avatars, collaborative whiteboarding, browser-based platforms, and user engagement. Studies from 2017 to 2025 were analyzed to understand strengths like WebRTC's low latency and challenges like scalability or complex interfaces. Parameters included engagement, impact, accessibility, and professional usability. The findings showed that while gamified elements boost motivation, overly complex designs can overwhelm users, and browser-based tools ensure broad access. These insights shaped Collabio's design to prioritize a simple 2D space, efficient whiteboarding, and scalable video calls, keeping professional functionality first.

## **Brief description of the methodology**

Collabio was developed using an agile approach with bi-weekly sprints. The platform uses a client-server setup with a React.js TypeScript frontend for user interactions, p5.js for avatar animations and Tldraw for whiteboarding. The backend runs on Node.js with Socket.io for real-time updates and LivekitCloud for WebRTC video calls. Key features include avatar navigation (arrow keys jumping), proximity-based video calls (within 100 pixels), global chat (500-char limit) and a whiteboard with 500ms debounced updates. Testing involved unit integration, user and stress tests to ensure performance. Deployment used Vercel for frontend, Railway for backend with LivekitCloud handling video streams. Cross-browser compatibility was tested on Chrome, Firefox and Safari with partial mobile support.

## **Summary of results**

Collabio successfully delivered all features. Avatars move smoothly at 60 FPS (15 FPS on 2G) video calls start in 80ms, whiteboard syncs in 450ms and chat delivers in 50ms. It handled 50 users with <100ms lag. Tests with 10 classmates showed 90% found it easy to use, mastering navigation in <3 minutes. Users liked the natural proximity-based chats, fun jumping animations and random backgrounds, but 20% noted mobile browser issues suggesting better mobile support and avatar customization. Challenges like WebRTC setup and slow network performance were fixed with throttling, debouncing and LivekitCloud. Collabio offers a dynamic, accessible platform surpassing traditional tools by enabling spontaneous, engaging teamwork for schools, businesses and social groups.