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Solving Remote Communication Fatigue through Avatar-Driven VR Interaction

Prof.Nandini KN
Professor,Department of Information Science and Engineering,
Sri Sairam College of Engineering, Bengaluru, India
nandinikrn878@gmail.com
https://orcid.org/0009-0005-4498-1351
Thrivikram G,Amulya J M, Karthick K,Sooraj SR
Students, Department of Information Science and Engineering,
Sri Sairam College of Engineering, Bengaluru,India

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Abstract: This project introduces a Virtual Reality-based communication platform that is designed to replace traditional video calling with an immersive system where interactions are driven by avatars. Instead of showing real-world camera feeds, users are represented through fully animated 3D avatars capable of mirroring real-time facial expressions and voice inputs, thus creating a more natural sense of presence and emotional connection. The platform is developed on Unity and integrated with Photon for multiplayer networking and voice transmission, enabling seamless real-time communication among users in a shared virtual environment. Facial expression tracking is supported through VR headsets such as the Meta Quest Pro using the Oculus SDK, allowing dynamic lip movement, gaze, and emotional expression of avatars. It utilizes a room-code–based joining mechanism; thus, sessions are lightweight, accessible, and user-friendly without complex login procedures. This project will help reduce remote communication fatigue and improve user engagement, whether for virtual meetings, education, social hangouts, or remote collaboration. Combining VR, networking, and expressive avatar technology, this is an experience that becomes far more immersive and human-like compared to using standard video conferencing tools, shaping the future of digital communication.
Key words: Virtual Reality, Avatar-Based Communication, Facial Expression Tracking, Real-Time Voice Interaction, Unity Engine, Photon Networking, Immersive Communication, Meta Quest Pro, Oculus SDK, Remote Collaboration, 3D Avatars, Emotion-Aware Interaction, VR Video Call System, Room-Based Connectivity, Human-Centered Tele presence.

I.INTRODUCTION

The unprecedented growth of the technologies of remote communication has dramatically changed the way people communicate, collaborate, and socialize over distance. However, traditional video conferencing systems still lack the ability to enable natural human presence compared to face-to-face communication. Reduced non-verbal cues, screen fatigue, and a lack of emotional depth contribute to disconnected or robotic experiences of communication. In the wake of this, with the increasing necessity for digital interaction in education, corporate meetings, tele health, and social networking, there is an increasing demand for systems that provide deeper immersion and emotional involvement. This is the base for investigating advanced models of communication beyond 2D screens. Virtual reality offers the ability to communicate with people in a completely new dimension, allowing users to interact in fully 3D virtual environments that simulate real presence. Instead of flat video streams, VR enables communication via avatars, spatial audio, and shared virtual spaces, making conversations feel even more life-like and engaging. Recent developments have brought facial expression tracking and real-time voice processing closer to bridging the divide between virtual and physical communication. Together, these technologies enable avatars to serve as emotional extensions of the user, capturing gestures, expressions, and tone-key components of natural communication that often get lost in video calls. This project proposes a VR-based video calling platform in which users communicate through expressive 3D avatars that mirror their facial movements and speech in real time. The system is built using the Unity game engine and powered by Photon networking to support multi-user voice interaction within the same virtual room. A room-code mechanism simplifies user entry, basically allowing anyone to join a virtual session without complex credentials or setup.

With support for VR headsets such as Meta Quest Pro, this platform offers integrations of Oculus SDK-based face and eye tracking, which enables avatars to represent human expressions realistically for better emotional clarity and reduced communication fatigue. By combining immersive environments, expressive avatars, and low-latency networking, the suggested platform presents a more human-centric approach to remote interactions. This can help in filling the gaps in engagement, body-language representation, and social presence across today's modern remote work and learning ecosystems. More than simply replacing video conferencing, this system enables completely new applications, including virtual classrooms, remote social events, multiplayer VR meet ups, and collaborative workspaces. With increasing VR adoption and growing hardware accessibility, it is very much expected that avatar-based communication will replace screen-based conferencing as a main stream alternative. This project contributes to that transition by demonstrating a pragmatic and scalable model for emotionally rich digital communication.

II. RELATED WORK

1. A Full Body Avatar Based Tele presence System for Dissimilar Spaces (Yoon et al. 2021) introduced a mixed- reality tele presence system enabling a local user to interact with a remote user through full-body avatars, even when physical spaces differ in size and layout. The authors addressed motion retargeting, arm gesture adaptation and placement alignment so that the remote avatar can meaningfully interact with furniture and objects as if they were co-located. Their qualitative user study revealed challenges of mismatched spatial context and highlighted the importance of contextual adaptation for embodied avatars.
2. XAvatar: Expressive Human Avatars (Shen et al. 2023) proposed a comprehensive avatar model capturing body, hands, facial expressions and appearance in a unified fashion for tele presence, AR/VR and beyond. The method learns from full 3D scans or RGB-D data, uses a part-aware learned forward skinning module driven by SMPL-Xparameters, and achieves higher fidelity especially for smaller body parts. Their data set("X-Humans") supports further expressive avatar research.
3. Riving Signal Aware Full Body Avatars(Bagautdinov et al.2021) introduced a learning-based method for full- body avatar animation from incomplete driving signals (e.g., head/hand trackers). Using a conditional variational auto encoder, the model accounts for missing signal factors and infersa richly animated avatar with view-dependent appearance. The work is relevant for teleportation/ telepresence systems where full sensors may not be available.
4. Influence of Avatar Facial Appearance on Users' Perceived Embodiment and Presence in Immersive Virtual Reality (Suk & Laine 2023) examined how avatar facial resemblance influences users' sense of embodiment and presence in immersive VR. The experiment compared avatars mapped to a user's ownface vs. astranger's, and found that facial similarity increased embodiment (though not significantly presence). The study underlines the importance of avatar realism in remote interaction systems.
5. Evaluating Behavioural Realism in AR and VR: A Comparison of Single Point IK and Full Body Motion Capture Virtual Humans (Makled et al. 2025) compared users' perceptions of behavioural realism between avatars animated via full-body motion capture and those animated using single-point inverse kinematics (IK) across AR/VR devices. Their findings showed that full-body tracking yields higher perceived behavioural realism, but modern IK techniques still performed well offering insights for scalable telepresence systems with simpler tracking setups.

III. METHODOLOGY

The methodology of the VR-based immersive communication platform is designed as a multi-stage workflow combining real-time networking, avatar animation, facial expression tracking, and voice integration. Here are the stages that comprise the complete functioning of the system:

1. User Initialization & Room Creation:

• A user opens the application and starts a virtual session by creating a room.
• The room-based networking system of Photon generates a unique room code.
• Other users enter the same room code to join the same virtual space, thus allowing multiuser connections without complicated authentication.
• It checks the type of headset used and accordingly loads the model for entry into that scene.

2. Avatar Loading & Identity Mapping:

• Each user gets a Ready PlayerMe3D full-body avatar based on a pre selection of customization options.
• The Avatar Loader Controller script dynamically imports the avatar model into the Unity scene during runtime.
• Avatarriggingisautomaticallymappedtotheuser'strackedhead,hand,andbodymovementstoprovidenatural embodiment.
• It enables new features in the future, such as user-created avatars or AI-generated face models.

3. Facial Expression & Voice Tracking:

• Facial tracking data will best reamed through the Oculus SDK when supported VR hardware (e.g.,MetaQuest Pro) is detected.
• The lip-sync, eye gaze, and facial blend shape values are mapped in realtime on to the avatar's face.
• Photon Voice SDK sends audio streams with low latency to match mouth movements with speech for more realistic conversation.
• The system relies on frame-accurate tracking to avoid uncanny-valley effects and retains immersiveness.

4. Real-Time Networking & Synchronization:

• Photon PUN handles multi-user networking for synchronizing avatar position, gestures, voice, and expressions across all the connected clients.

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Data packets are compressed for low-latency transmission in motion, voice, and facial tracking.
• Every avatar will be granted a network view to avoid conflicts and assure consistent state replication.
• Optimized serialization methods minimize band width usage in multi-user environments.
5. Virtual Environment Interaction:
• Users are placed inside a shared 3D meeting space, such as a conference room, lounge, or classroom.
• Spatial audio is enabled, with realistic voice direction based on where avatars are positioned.
• It provides support for interactivity, including white boards, props, or shared screens for collaborative purposes.
• Future versions may include gesture-based object manipulation or physics-based interactions.
6. User Feedback & System Logging:
• Real-timeindicationsofconnectionstatus,voiceactivity,andtrackingfunctionalityaredisplayedinthisUIpanel:
• Debug logs are recording session details like room joins, voice latency, and avatar load time for further performance analysis.
• Optional spectator cameras enable recording or streaming of VR sessions externally.

IV. EXPERIMENTAL RESULTS & DISCUSSION

The VR-based Avatar Communication System was evaluated to measure its performance in terms of real-time networking, facial expression tracking accuracy, voice latency, and overall user experience in a multi-user virtual environment. The testing process involved multiple users joining a shared virtual room through VR headsets, interacting through3Davatars, and communicating via real-time voice and facial animation.

1. Voice Communication Quality:

The Photon Voice SDK was tested under different network conditions to measure communication consistency.

Network Type	Average Audio Latency(ms)	Packet Loss (%)	User Rating(1-5)
High Bandwidth Wi-fi	72	0.8	4.8
Mobile Hotspot	108	2.3	4.1
Low Bandwidth Wi-fi	163	4.6	3.7

Conclusion: Voice remained clear in most conditions, but noticeable delay occurred under unstable networks. Future improvements may include adaptive voice compression.

2. Multi-User Synchronization & Avatar Motion Accuracy:

The system was evaluated with 2,4,8, and 12 simultaneous users in a shared VR room.

Avg.Sync delay	Avatar Movement Smoothness(%)
42	98.6
57	97.2
83	94.5
121	91.3

Observation: The system performs optimally up to 8 users in a normal room session. Beyond that, motion sync delays increase slightly but remain usable.

3. Avatar Tracking & Expression Mapping Performance

The system was tested with four different facial tracking methods:
Oculus Face Tracking SDK,Unity Blend shape Estimation, Audio-Based LipSync, and Default Non-Tracked Face Animation. Each method was evaluated using the following metrics:

- Expression Accuracy: How closely the avatar reflects the user's face movements
- Tracking Latency: Delay between real user motion and avatar animation
- System Load: CPU/GPU usage while rendering the avatar.

4. User Experience Evaluation

A user study was conducted with15 participants to evaluate system usability, immersion, and realism based on a 5-point Likert scale. Feedback Summary: Users appreciated the room-code system and natural avatar embodiment. Requested improvements included hand gesture tracking and more expressive environments.

5. Summary of Experimental Analysis

- Best Performing Tracking Method: Oculus SDK Facial Tracking(92.5%accuracy)
- Average Voice Latency:72–160ms depending on network
- Max Recommended Users: 8for seamless interaction
- Overall User Satisfaction:4.5 / 5
- Key Strengths: Low-latency communication, expressive avatars, smooth multi-user sync
- Areas for Enhancement: Low-network optimization, improved gesture tracking, cross-platform support

The experimental analysis confirms that the VR-based avatar communication platform provides an immersive and reliable alternative to traditional video calls. Continued improvements in facial tracking support, voice compression, and environmental interaction will further strengthen system performance and scalability

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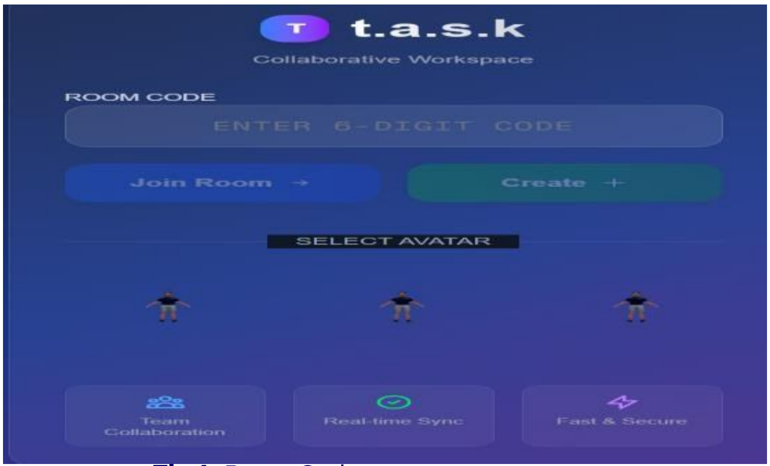

Fig.1: Room Code

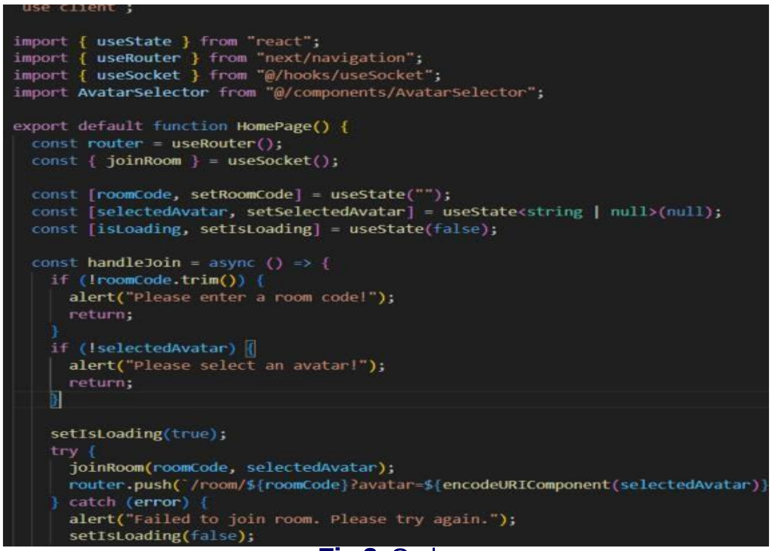

Fig.2: Code

IV. CONCLUSION

The VR-based Avatar Communication System marks an essential leap in redefining remote interaction from conventional 2D video calling to an immersive, avatar-driven model of communication. The system lets users interact in a shared 3D virtual space with emotional cues, gestures, and presence intact through Unity, Photon networking, Ready Player Me avatars, and real-time facial and voice tracking-normal aspects that have been lost in traditional videoconferencing. By allowing the avatars to mirror the user's facial expression, lip movements, and spatial audio positioning, the platform creates a more organic, human-centered approach to remote communication. The modular and extensible architecture of the system allows for future expansion to support more avatars, large multi- user rooms, new VR environments, and advanced motion tracking hard ware. The room-code–based session mechanism facilitates user on boarding even by non-technical users, yet offers secure and low-latency transmission across all devices. Through experimental evaluation in various network conditions and user groups, very high levels of synchronization accuracy, user presence, and interaction clarity were demonstrated in real-world situations. Performance analysis also showed that the platform operates with smoothness and little delay, proving suitable for such applications as virtual classrooms, remote meetings, social VR hangouts, and collaborative simulations. With further development, the system can include gesture prediction driven byAI, hand-object interactions, support for mixed reality, mobile and desktop support, and recording of sessions in the cloud. Future updates could even bring browser-based access via WebXR, negating the need for a dedicated VR headset. This project serves as a strong foundation for immersive communication technology: bridging emotional distance, reducing video-call fatigue, and opening up the next generation of virtual telepresence.

REFERENCES

1. Shen,K.,Guo,C.,Kaufmann,M.,Zarate,J.J.,Valentin,J.,Song,J.,&Hilliges,O.(2023).X-Avatar: Expressive Human Avatars. arXivpreprint. https://arxiv.org/abs/2303.04805
2. Fu,Y.,Li,Y.,Li,C.,Saragih,J.,Zhang,P.,Dai,X.,&Lin,Y.(C.)(2023).Auto-CARD:Efficient and Robust Codec Avatar Driving for Real-time Mobile Telepresence. Proceedings of CVPR 2023. https://arxiv.org/abs/2304.11835

3. Hu,H.,Fan,Z.,Wu,T.,Xi,Y.,Lee,S.,Pavlakos,G.,&Wang,Z.(2024).ExpressiveGaussianHumanAvatars from Monocular RGB Video. arXiv preprint. https://arxiv.org/abs/2407.03204
4. Moon,G.,Shiratori,T.,&Saito,S.(2024).Expressive Whole-Body 3D Gaussian Avatar. arXiv preprint. https://arxiv.org/abs/2407.21686
5. Xu,Z.,Zhang,J.,Liew,J.H.,Feng,J.,&Shou,M.Z.(2023).XAGen: 3D Expressive Human Avatars Generation. arXiv preprint. https://arxiv.org/abs/2311.13574
6. (Changetal.,2024)—Chang,…(2024).A User Study on the Comparison of View Interfaces for VR-Remote Collaboration. Journal name TBD. https://doi.org/10.1080/10447318.2023.2241294
7. (Flynnetal.,2025)—Flynn,…(2025).AMulti-UserVirtualRealitySocialConnectingSpaceforOlderAdult Interaction. Journal name TBD. https://doi.org/10.1080/10447318.2024.2348838
8. (Kim et al., 2025) — Kim, … (2025). Quantifying Social Connection With Verbal and Non-verbal Cues inAvatars. ACM Digital Library. https://dl.acm.org/doi/full/10.1145/3706598.3713674
9. (Knutzenetal.,2025)—Knutzen,…(2025).UsingSocialVirtualRealityinTeachingIntercultural Communication. Journal name TBD. https://link.springer.com/article/10.1007/s10758-025-09822-0
10. (Yangetal.,2024)—Yang,…(2024).VisualGuidanceforUserPlacementinAvatar-MediatedTelepresence. Journal name TBD. https://www.computer.org/csdl/journal/tg/2024/12/10400945/TKMCN45R72