**Enhancing Participation Experience in VR Live Concerts by Improving Motions of Virtual** **Audience Avatars** (https://ieeexplore.ieee.org/document/9284728)

• What is the research problem addressed by each paper?  
• Why is the problem considered challenging in the research domain?  
• Why is it important to address such problem?  
• What is the proposed solution for each paper?  
• How is mixed reality increasing immersion in the context?  
• What concept or ideas did you gain from the papers to design your virtual world?  
• What are the several dimensions of collaborative space?  
• What are the key characteristics of previous designs with respect to your envisioned  
solution?  
• What are the key elements of a good collaboration space concept?

1. What is the research problem addressed by the paper?: The study investigates the problem of the VR concert experience and user participation compared to real life. It addresses the social engagement of a small group of or single user(s) in vr concert environments as currently, when a small number of users are watching alone, they cannot adequately enjoy the social aspect of live participation. The absence of interaction diminishes the immersion of VR concerts
2. Why is the problem considered challenging in the research domain?: Authentic social interactions in VR is quite technically and conceptually difficult. Most VR concerts depend on real-time user data to mirror audience movements, but when there are only a few users present, this can be isolating. Also, network latency can disrupt synchronized movements, which can be off putting to users and just mirroring the users movements can also feel inauthentic to the concert experience. The challenge is to create believable and engaging virtual crowds without relying solely on real-time data.
3. Why is it important to address such a problem?  
   It is important to address this problem as social interaction is central to the concert experience. As remote events become more common, it is important to bridge the gap between the virtual and physical to avoid the concerts feeling artificial to the users, reducing engagements.
4. What is the proposed solution for the paper?  
   The authors propose four methods to improve virtual audience avatars:
   * Copying the user's own movements to surrounding avatars.
   * Copying movements from other users who have previously attended the same concert.
   * Repeating beat-synchronous movements based on the song’s rhythm.
   * Synthesizing movements using machine learning, which generates avatar behaviour based on the acoustic features of the music.
5. How is mixed reality increasing immersion in the context?: Mixed reality increases user immersion by making the virtual concert environment feel more real to the user. With virtual audience members exhibiting realistic movements to the music, users will feel more immersed in the experience as part of a larger engaged social group, enhancing emotional and sensory connection to the experience
6. What concepts or ideas did you gain from the paper to design your virtual world?
   * Machine Learning for Avatar Movement: Using algorithms to sync audience avatars with the music enhances the feeling of realism.
   * Beat-Synchronous Animations: Incorporating movements that align with musical rhythms can make the environment feel more interactive.
   * User Interaction Layering: Combining real-time user data with pre-recorded audience movements to create a consistent social atmosphere.
   * Avoiding Self-Replication: Users found it creepy when their movements were mirrored, so designing distinct, natural crowd behaviours is key.
7. What are the several dimensions of collaborative space?
   * Co-Presence: The sense of being with others in the virtual concert environment.
   * Interactivity: How users engage with both the performance and other audience members.
   * Synchronization: Shared reactions to the performance, like cheering, clapping, or dancing in unison.
   * Social Feedback: Visual cues from avatars (e.g., waving glow sticks) that mimic real-world crowd behavior.
8. What are the key characteristics of previous designs with respect to your envisioned solution?  
   Previous designs, like those in Oculus Venues, relied heavily on mirroring real-time user movements, assuming that many users would attend the concerts simultaneously. This limited the experience when audience numbers were low or when users were watching alone.
9. What are the key elements of a good collaboration space concept?
   * Realistic avatar behaviour
   * Providing engaging experiences whether the concert is live-streamed or pre-recorded.
   * Low Latency.
   * User Comfort: Avoiding uncanny or unsettling behaviours.
   * Allowing users to personalize their avatars or reactions.