Akash Annotated Bibliography

Paper – 1:

Title: "Virtual Reality Sickness Mitigation Methods: A Comparative Study in a Racing Game."

This paper, authored by Rongkai Shi, Hai-Ning Liang, Yu Wu, Difeng Yu, and Wenge Xu, was published in the Proceedings of the ACM on Computer Graphics and Interactive Techniques, Vol. 4, No. 1, in May 2021. The study investigates methods to mitigate virtual reality (VR) sickness in the context of a racing game.

Paper Link: https://ar5iv.org/pdf/2103.05200.pdf

VR sickness, akin to motion sickness, is a major hindrance in the immersive VR experience, often leading to discomfort and reduced user performance. Understanding and mitigating VR sickness is crucial for the wider adoption and enjoyment of VR technologies, especially in interactive environments like games. The study aims to understand their impact on VR sickness, presence, workload in a search task, and information loss in a racing game with two levels of control. The study employed a mixed factorial design with 'degree of control' as a between-subjects factor and 'VR sickness mitigation techniques' as within-subjects factors. Participants were asked to find targets in a VR environment, which simulated driving a car, under varying conditions of control and VR sickness mitigation methods. The study found that while the mitigation techniques did not significantly differ in their impact on VR sickness, presence, or workload, they varied in how they affected information loss. Techniques that altered the user's FOV or applied DOF blur resulted in loss of visual information, whereas adding a target reticule did not. This insight is crucial for designing VR experiences that are both comfortable and informationally rich.

Paper – 2:

Title: "You’re in for a Bumpy Ride! Uneven Terrain Increases Cybersickness While Navigating with Head Mounted Displays,"

This paper authored by Samuel Ang and John Quarles from The University of Texas at San Antonio, published in the 2022 IEEE Conference on Virtual Reality and 3D User Interfaces.

Paper Link: https://ieeexplore-ieee-org.ezproxy.lib.uwm.edu/stamp/stamp.jsp?tp=&arnumber=9756773&tag=1

Cybersickness, akin to motion sickness, is a significant barrier to VR technology adoption. Understanding its causes and mitigation is vital, especially as VR finds applications in various fields, including gaming, training, and therapeutic interventions. This paper investigates how navigating uneven virtual terrain in a forest environment affects cybersickness in users of head-mounted displays (HMDs). The study involved 38 participants navigating three types of terrain: flat, with regular bumps, and irregular terrain generated from Perlin noise. The study employed a within-subjects design, with participants experiencing each terrain type in a counterbalanced order. They navigated a virtual forest using a steering metaphor, while

their cybersickness levels were assessed through subjective (FMSS and SSQ) and physiological (galvanic skin response) measures. The study found that uneven terrain, whether with regular bumps or irregular patterns, increased cybersickness compared to flat terrain. However, there was no significant difference in cybersickness levels between the two types of uneven terrain. These findings highlight the importance of terrain design in VR environments and its impact on user comfort and experience.

Paper – 3:

Title: "Evaluating the Effects of Virtual Reality Environment Learning on Subsequent Robot Teleoperation in an Unfamiliar Building."

The authors, Karl Eisenträger, Judith Haubner, Jennifer Brade, Wolfgang Einhäuser, Alexandra Bendixen, Sven Winkler, Philipp Klimant, and Georg Jahn, published it in IEEE Transactions on Visualization and Computer Graphics, Vol. 29, No. 5, May 2023.

Paper Link: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=10049647

With the increasing application of teleoperated robots in various fields, effective training methods for operators are essential. VR offers a unique way to familiarize operators with remote environments, potentially enhancing their navigation and orientation skills. The paper examines the use of Virtual Reality (VR) for preparing individuals to teleoperate robots in unfamiliar environments. It compares the effectiveness of learning through a traditional building plan with two VR learning methods: normal-sized and giant-sized avatar perspectives. The study involved 66 participants, divided into three groups, each using a different learning method. Participants were randomly assigned to one of the three learning methods: studying a building floor plan, exploring a VR model with a normal-sized avatar, or a giant-sized avatar. Following the learning phase, they performed orientation and navigation tasks using a teleoperated robot in an unfamiliar building. The study found that VR-based learning methods, especially the giant-sized avatar perspective, significantly improved participants' performance in orientation and navigation tasks compared to the traditional building plan method. This suggests VR's potential as a valuable tool in preparing for teleoperation in unfamiliar environments.

Paper – 4:

Title: "The Dating Metaverse: Why We Need to Design for Consent in Social VR"

The authors Douglas Zytko and Jonathan Chan, published in the IEEE Transactions on Visualization and Computer Graphics in May 2023.

Paper Link: https://ieeexplore.ieee.org/document/10049740

As social VR applications, including dating platforms, become more prevalent, ensuring user safety and consent becomes paramount. The study addresses the lack of focus on safety within VR dating environments and seeks to inform designs that prioritize user consent and harm prevention. This paper presents a participatory design study examining the necessity of incorporating consent mechanisms in social Virtual Reality (VR), particularly in VR dating applications, termed the dating metaverse. The

study involved 18 participants from the Midwest United States who envisioned VR dating environments and consent mechanics to mitigate potential harms, like harassment. The study employed participatory design workshops, enabling participants to create designs for VR dating environments that emphasize consent. It aimed to uncover potential harms in such spaces and develop solutions to mitigate these risks. The research highlighted the need for explicit consent mechanics in social VR, especially in dating contexts. Participants proposed various designs, such as consent bubbles and informed consent mechanisms, to ensure safe and consensual interactions. The findings underscore the significance of designing VR environments that prioritize user safety and consent, particularly in socially charged contexts like dating.

Paper – 5:

Title: "RemoteTouch: Enhancing Immersive 3D Video Communication with Hand Touch,"

This paper is authored by Yizhong Zhang, Zhiqi Li, Sicheng Xu, Chong Li, Jiaolong Yang, Xin Tong, and Baining Guo from Microsoft Research Asia and Zhejiang University, published on February 28, 2023.

Paper Link:
https://www.researchgate.net/publication/368878151_RemoteTouch_Enhancing_Immersive_3D_Video_Communication_with_Hand_Touch

The motivation behind this research is to bridge the physical gap in virtual meetings and enhance the sense of presence and interaction. This is particularly relevant as remote communication is becoming increasingly prevalent. The paper introduces 'RemoteTouch,' a novel method enhancing immersive 3D video communication by emulating hand touch. The study focuses on creating a more interactive and realistic virtual meeting environment where participants can experience a sense of touch, akin to a hand clap or high five, through a screen. The method involves a dual representation of the hand, using both image-based and 3D geometry-based models, to render the hand in a virtual environment realistically. This dual approach allows for high-quality rendering of the hand, especially during close screen interactions. The results show that RemoteTouch effectively enhances the immersive experience in 3D video communication. It successfully renders realistic hand interactions, providing users with a more engaging and interactive virtual meeting experience.

Paper – 6:

Title: "Eye Tracking in Virtual Reality"

This is authored by Viviane Clay, Sabine U. Koenig, and Peter König from the University of Osnabrück, published in the Journal of Eye Movement Research in April 2019.

Paper Link:
https://www.researchgate.net/publication/332780872_Eye_Tracking_in_Virtual_Reality

The paper addresses the emerging need for precise eye tracking in VR, driven by VR's growing use in research and consumer markets. The combination of VR and eye tracking opens new possibilities for

studying human cognition and behavior in immersive environments. This paper provides an overview of eye tracking techniques in virtual reality (VR) environments. It discusses the integration of eye tracking into VR, its potential applications, and the technical challenges involved. The authors detail the technical aspects of integrating eye tracking into VR systems, including hardware and software requirements, calibration techniques, and data analysis methods. They provide guidance on setting up and implementing VR eye tracking in laboratory settings. The authors emphasize the advantages of combining eye tracking with VR, such as enhanced research capabilities in human perception and behavior studies. The paper highlights the effectiveness of VR eye tracking in providing detailed insights into user interactions and behaviors in virtual environments. It demonstrates how this technology can be used to study complex cognitive processes and user experiences in a controlled yet realistic setting.

Paper – 7:

Title: "Cyber Security Threats and Challenges in Collaborative Mixed-Reality"

This paper is authored by Jassim Happa, Mashhuda Glencross, and Anthony Steed from the University of Oxford and University College London, published in Frontiers in ICT in April 2019.

Paper Link: https://www.frontiersin.org/articles/10.3389/fict.2019.00005/full

The rapid growth of CMR technologies in various sectors like gaming, healthcare, and social interaction necessitates an in-depth understanding of their security challenges. The paper seeks to address the limited research in this area by outlining potential cyber threats and strategies for mitigation. This paper examines cybersecurity threats in Collaborative Mixed-Reality (CMR) environments, focusing on potential attacks and their implications. It discusses how CMR's unique properties, like immersive and interactive experiences, introduce new security vulnerabilities. The authors use a systematic approach to categorize potential attack vectors in CMR. They propose an attack taxonomy and examine the CMR attack surface through various use-case scenarios, illustrating the potential risks and impacts of cyber threats in these environments. The findings highlight a range of security concerns, including data privacy, user manipulation, and system integrity. The paper suggests defense strategies and emphasizes the importance of developing robust security measures tailored to the unique challenges of CMR.

Paper – 8:

Title: "Comparing the Neuro-Physiological Effects of Cinematic Virtual Reality with 2D Monitors"

This paper isauthored by Ruochen Cao, Lena Zou-Williams, Andrew Cunningham, James Walsh, Mark Kohler, and Bruce H. Thomas from the University of South Australia and University of Adelaide, published in the 2021 IEEE Virtual Reality and 3D User Interfaces (VR).

Paper Link: https://ieeexplore.ieee.org/document/9417729

The research explores whether the immersive nature of VR can enhance cognitive integration of information, particularly in comparison to 2D visual presentations. This paper investigates the neurophysiological effects of Cinematic Virtual Reality (CVR) compared to traditional 2D monitors. The

study, involving 32 participants, used electroencephalography (EEG) to measure brain responses while viewing 3D animated scenes in both CVR and 2D environments. Participants were exposed to 3D animated scenes in both a non-CVR environment (monitor) and a CVR environment (head-mounted display). EEG was utilized to record cortical responses, focusing on early visual attention and alpha power. The findings revealed that CVR environments engage early visual attention more effectively and show higher overall alpha power, potentially indicating lower mental effort in processing visual information. However, the impact on recall performance was not significant, suggesting that the immersive nature of CVR does not necessarily enhance memory encoding compared to 2D displays.

Paper – 9:

Title: Multi-View Merging for Robot Teleoperation With Virtual Reality

Authors: Dong Wei, Bidan Huang, Qiang Li

Publication: IEEE Robotics and Automation Letters, Vol. 6 No. 4, October 2021

Paper Link: https://ieeexplore.ieee.org/abstract/document/9528927

Robotic teleoperation, where a human operator controls a remote robot, often faces challenges like steep learning curves and poor telepresence due to limited visual feedback. This research addresses these issues by integrating state-of-the-art VR technology to provide operators with an intuitive and efficient interface for teleoperation tasks. This paper presents a novel interface for robotic teleoperation using virtual reality (VR), enhancing telepresence by merging visual information from multiple views. The interface merges visual information from a static global stereo camera and a local RGB-D camera mounted on the robot's end-effector. This setup provides a comprehensive view of the workspace, overcoming occlusion issues. The paper details the system design, including the VR setup, algorithm for dynamic calibration, and integration of the multi-view interface. User studies demonstrate the superiority of the proposed interface over traditional Picture-in-Picture (PIP) methods in terms of task performance, efficiency, and user preference. The findings suggest that multi-view merging in VR can significantly improve teleoperation by providing more intuitive and effective visual feedback.

Paper – 10:

Title: The Role of Virtual Reality in Autonomous Vehicles' Safety

Authors: Alexandre M. Nascimento, Anna Carolina M. Queiroz, Lucio F. Vismari, Jeremy N. Bailenson, Paulo S. Cugnasca, João B. Camargo Junior, Jorge R. de Almeida Jr

Published: in 2019 IEEE International Conference on Artificial Intelligence and Virtual Reality (AIVR)

Paper Link: https://ieeexplore.ieee.org/document/8942308

Given the rise in AV technology, ensuring their safety is crucial. The paper addresses the lack of comprehensive studies on the role of VR in enhancing AV safety, acknowledging the potential of VR in creating realistic simulation environments for AV testing and training. This paper explores how virtual

reality (VR) can enhance the safety of autonomous vehicles (AVs). The authors conduct a systematic literature mapping, reviewing existing studies on VR and AV safety. They analyze the role of VR in AV training, testing, and human-vehicle interaction to assess its effectiveness and potential areas for further research. The paper concludes that VR is an underutilized tool in AV safety. It effectively creates simulation environments for testing and training AVs, reducing risks and costs compared to real-world setups. The study also suggests further exploration of VR applications in AV development, emphasizing its potential in enhancing AV safety.

Paper – 11:

Title: The Application of Virtual Reality in Games

Authors: Jinpei Song, Kaiwen Yang, Juncheng Yang

Publication: 2022 IEEE 2nd International Conference on Data Science and Computer Application (ICDSCA)

Paper Link: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9988576

The motivation behind this research is to understand how VR technology has transformed the gaming experience, making it more immersive and interactive. The paper explores the development of VR and its growing significance in enhancing gaming experiences, with a focus on specific game genres. The authors discuss the evolution and characteristics of VR, emphasizing immersion, interactivity, and multisensory experiences. The authors conduct a comprehensive review of the literature on VR and its application in gaming. They examine the technological advancements in VR and analyze their implications in various gaming scenarios. The paper concludes that VR has significantly enhanced the gaming experience by providing immersive and interactive environments. It has revolutionized game design, particularly in horror and escape room games, by offering more realistic and engaging experiences. The study also suggests that VR has substantial potential to impact the gaming industry both economically and socially.

Paper – 12:

Title: Object Selection in DeskVR

Authors: Joao Miguel Monteiro

Publication: Mestrado em Engenharia Informática e Computação, July 29, 2022

Paper Link: https://repositorio-aberto.up.pt/bitstream/10216/142735/2/572014.pdf

This aims to address the challenge of object selection in DeskVR - a virtual reality setup suited for desk-based professional environments. It recognizes the need for efficient object selection methods that minimize physical exertion, enhancing productivity and comfort in professional VR applications. The study presents the TouchRay method, designed for selecting objects in a DeskVR setting. Experiments were conducted to compare TouchRay with existing object selection techniques, assessing their suitability

and effectiveness in a DeskVR scenario. The experiments revealed that while TouchRay did not universally outperform existing methods, it showed advantages in specific DeskVR use cases. This suggests that custom solutions like TouchRay can enhance user experience in desk-based VR environments, particularly for professional applications.

Paper – 13:

Title: Digital Twins and Virtual Reality as Means for Teaching Industrial Robotics: A Case Study

Authors: Iyari Alejandro Nava-Téllez, Milton Carlos Elias-Espinosa, Eduardo Bastida Escamilla, Arturo Hernández Saavedra

Publication: 2023 11th International Conference on Information and Education Technology (ICIET)

Paper Link: https://ieeexplore.ieee.org/document/10111361

The paper investigates the potential of VR and DT to improve the quality and safety of education in industrial robotics. This is crucial given the increasing complexity and cost of robotics equipment, and the need for hands-on, practical training in this field. The research involved creating a DT of a manufacturing cell using Robo DK and SolidWorks, which students then used to program and interact with various types of industrial robots in VR. The process included comparing virtual programming and interactions with physical real-world applications. The results indicated that integrating VR and DT into robotics education can significantly enhance learning outcomes. It provides a safe and effective environment for students to experiment and learn, potentially improving quality, productivity, and efficiency in industrial processes.

Paper – 14:

Title: Procedurally Generated Virtual Reality from 3D Reconstructed Physical Space

Authors: Misha Sra, Sergio Garrido-Jurado, Chris Schmandt, Pattie Maes

Publication: Proceedings of the 22nd ACM Symposium on Virtual Reality Software and Technology, 2016

Paper Link: https://dl.acm.org/doi/pdf/10.1145/2993369.2993372

The research aims to enhance VR immersion by enabling natural walking and interaction in virtual environments that mirror real physical spaces. This addresses limitations in current VR systems, which often require large, clear spaces or rely on artificial locomotion methods. This paper introduces a novel system that generates virtual reality (VR) environments using real-world physical spaces as templates. The system, implemented on Google's Project Tango, captures indoor scenes in 3D, identifies walkable areas, and maps these onto a virtual environment, allowing for natural walking and interaction. The system employs 3D mapping, obstacle detection, object detection and tracking, automatic virtual environment generation, and haptic feedback. It uses a mobile device for creating 3D maps of the environment, identifying walkable areas, and generating corresponding virtual worlds. The system successfully creates immersive VR environments that allow users to walk and interact naturally. It

demonstrates the feasibility of using real-world spaces as templates for VR, offering a new direction for VR application development. The system's potential for various fields, including gaming and educational simulations, is notable, highlighting its impact on the future of VR technology.