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Editorial

The first Metaverse Scientist Forum was successfully convened virtually

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The first Metaverse Scientist Forum was successfully convened virtually on 7 March 2025, from 14:30 to 16:00. This pioneering session featured distinguished presentations by Prof. Adrian David Cheok from Nanjing University of Information Science and Technology and Dr. Shashi Kant Gupta of Eudoxia Research University. Academic leadership was provided by Prof. Pan Zhigeng, Dean of the Artificial Intelligence School at Nanjing University of Information Science and Technology, who chaired the forum, while Dr. Wang Wenxiao, a doctoral supervisor from Macau University of Science and Technology, was invited as moderator.

Dr. Adrian David Cheok: "Every sense Everywhere Human Communication"

Dr. Adrian David Cheok presented a groundbreaking presentation titled "Every Sense Everywhere Human Communication", detailing two decades of interdisciplinary innovation in multi-sensory XR (Extended Reality) systems. Building upon the foundational summary, this expanded analysis incorporates critical technical implementations, collaborative applications, and forward-looking implications from the presentation and outlines his pioneering research in human-computer sensory integration. The presentation systematically explored methodologies for synchronizing all five human senses with extended reality (XR) environments encompassing virtual, augmented, and mixed reality platforms.

The discussion began with early advancements in multi-sensory augmented reality (AR) developed during Dr. Cheok's work in Singapore. These included mixed reality (MR) systems that merged physical objects, such as sculptures, with digital overlays for military training purposes. These systems utilized custom-built head-mounted displays and spatial audio engineering to create interactive gaming experiences, laying the groundwork for modern smartphone-based AR applications. Notably, the presentation positioned auditory augmentation as a precursor to contemporary XR technologies, drawing parallels between the 1980s Walkman and current spatial audio systems in enhancing personal sensory experiences.

The discourse then progressed to tactile communication paradigms, demonstrating internet-mediated haptic interfaces capable of replicating interpersonal physical interactions—including pressure-sensitive embrace simulation and thermal-regulated kissing mechanisms—through advanced telepresence technologies. A significant focus was placed on tactile communication technologies. Initial prototypes, such as the Poultry Internet, enabled remote tactile interaction between humans and animals through pressure-sensitive interfaces. Subsequent developments included wearable "hugging pajamas" equipped with pneumatic actuators to simulate the physical sensation of embraces, and the Kissinger device, which used bidirectional

pressure sensors to transmit lip movements for remote kissing. These innovations demonstrated practical applications for maintaining emotional connections in long-distance relationships, particularly through compact wearable devices like haptic rings designed for everyday use.

The research also addressed non-chemical methods for digitizing taste and smell. Electrical stimulation of taste receptors via lingual electrodes was shown to replicate sour and sweet sensations, while programmable molecular vaporization devices mimicked specific scents without chemical additives. Collaborative projects with culinary experts, such as a partnership with a Michelin-starred chef, enabled the global transmission of dish-specific aromas, enhancing remote dining experiences.

Educational applications were illustrated through prototypes such as Cellular VR, which allowed students to explore biological systems using multi-sensory feedback: thermal cues simulated blood flow, olfactory markers represented biochemical processes, and haptic vibrations mimicked cellular interactions. In healthcare, tactile interfaces showed promise as assistive tools for visually impaired individuals, with preliminary studies indicating improved texture recognition. The presentation also speculated on future neuroprosthetic applications, proposing the integration of XR sensory inputs with cortical implants to partially restore vision, contingent on ongoing ethical and technical evaluations.

These sensory replication technologies demonstrated remarkable potential for revolutionizing multiple domains, such as social communication systems through enhanced virtual intimacy, immersive pedagogical frameworks for experiential learning, and medical assistive technologies for sensory-impaired populations. Dr. Cheok's research establishes a comprehensive framework for advancing XR technologies. The work underscores their potential to enhance social interaction, education, and healthcare in the future.

Dr. Shashi Kant Gupta: "Developing Responsible Researchers in the AI World"

Dr. Shashi Kant Gupta's presentation focused on developing responsible researchers in the artificial intelligence (AI) world. He outlined that responsible artificial intelligence research necessitates the incorporation of ethical frameworks that guide the development and deployment of artificial intelligence technologies, ensuring that considerations of fairness, accountability, transparency, and inclusivity are systematically integrated into every stage of the research process to promote societal well-being and mitigate potential harms.

Therefore, it is very important to define the meaning of responsible artificial intelligence research in terms of ethical framework integration. As Dr. Shashi Kant Gupta mentioned, the ethical considerations in AI development were analyzed through four dimensions: fostering public trust via robust standards, addressing implementation gaps in guideline adherence, mitigating algorithmic biases to prevent social inequities, and advancing collaborative solutions through multidisciplinary teams. Real-world exemplars illustrated practical applications of ethical AI, including IBM Watson's adherence to patient privacy in oncology decision-making, Microsoft's principles-driven development ensuring fairness and reliability, and Google's community-centered projects addressing global challenges through measurable

outcomes.

The key aspects of a training program for responsible artificial intelligence researchers include the role of ethics in AI development, transformative societal changes due to AI integration, case studies of responsible AI implementation, governance and accountability mechanisms, and the skills required for responsible AI research. Governance mechanisms were emphasized as critical to ethical AI deployment, encompassing policy development for life cycle management, proactive risk mitigation strategies, and stakeholder engagement to align technological outputs with societal values. Competencies for responsible researchers were identified, such as ethical decision-making to evaluate societal impacts, data literacy for bias detection, and collaborative communication to integrate diverse perspectives.

The presentation underscored the necessity of continuous learning to adapt to AI's rapid evolution, advocating agile methodologies and interdisciplinary collaboration to address emerging ethical dilemmas. Transparency was highlighted through documentation practices, open-source platforms, and real-time monitoring, while inclusivity initiatives stressed the integration of marginalized communities in AI design processes.

Dr. Shashi Kant Gupta also highlighted continuous learning, interdisciplinary collaboration, promoting transparency, engaging diverse perspectives, and future directions for AI ethics. The future directions focused on proactive ethical design to preempt risks, data governance frameworks to safeguard privacy, and global collaboration to reconcile cultural diversity in ethical standards. This research not only addresses current challenges but also establishes a foundation for sustainable AI ecosystems grounded in human-centered principles.

During the interdisciplinary exchange session, scholars engaged in comprehensive discussions encompassing several critical domains: Human-centered design challenges in multi-sensory convergence systems, neurocognitive implications of persistent sensory augmentation technologies, ethical frameworks for extended reality (XR) implementation, global governance standards for artificial intelligence ethics, and labor market transformations induced by AI-driven workforce displacement.

The success of this forum provides a high-level academic exchange platform for researchers in the field of metaverse, shows the possibilities of interdisciplinary research under the background of metaverse, and discusses the problems faced by the future development of artificial intelligence and the direction that relevant researchers need to learn.

Conflict of interest: The authors declare no conflict of interest.

Tianrun Jing received the B.S. in computer science from University of Western Ontario (UWO) in London, Ontario, Canada, in 2021. He received the M.Sc. in interactive media from Macau University of Science and Technology, Macau, in 2024. He is pursuing a Ph.D. degree in digital media from Macau University of Science and Technology. His research interests include artificial intelligence, human-computer interaction, computer vision, game engine design, virtual reality, and data analysis.

Wenxiao Wang is currently an assistant professor at Macau University of Science and Technology (MUST). He received a Ph.D. in science from the MUST School of Computer Science and Engineering in 2022. He is a member of ACM and CCF. His research focuses on digital twins, machine learning, signal processing, computer graphics, video game technology, and related fields. Over the past five years, he has published numerous peer-reviewed SCI and SSCI articles on digital twins, AI-assisted design, and facial stylization. He has also served as a reviewer for prestigious journals, including IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, IEEE Transactions on Consumer Electronics, International Journal of Computer Vision, Humanities & Social Sciences Communications, Scientific Reports, and The Visual Computer. Additionally, he has authored a co-published monograph with Tsinghua University Press. With more than 10 years of practical experience in digital twins, 3D reconstruction, machine learning, augmented reality (AR), virtual reality (VR), video game technology, and related areas, he has participated in numerous valuable projects in these fields.