

# SC27 WG5

# Security and Privacy Protection for Metaverse

11 April 2024

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# Agenda

1. System Avatar (NPC) & User Avatar (PC)  
Interaction Examples
2. Metaverse System Examples
3. Privacy Issues of Interaction in Metaverse
4. Privacy techniques in Metaverse platforms

# System Avatar (NPC) & User Avatar (PC) Interaction Examples

# Interaction between System Avatar and User Avatar

- Interactions between NPCs (Non-Player Characters) and users in metaverse systems are a crucial element of the virtual world. Here are some examples:
  - 1. Quest Assignment and Rewards:** NPCs assign specific tasks to users and provide rewards upon completion. For instance, in a medieval fantasy metaverse, a village resident NPC might give a user a quest to fetch a specific herb from a nearby forest.
  - 2. Shop Transactions:** NPC merchants operate virtual shops and trade items with users. Imagine a holographic NPC selling high-tech items in a cyberpunk-style metaverse.
  - 3. Conversation and Information Provision:** NPCs engage in conversations with users, providing information or hints about the game world. For example, in a space exploration metaverse, an alien NPC could explain the history and culture of a planet to the user.
  - 4. Education and Training:** NPC instructors teach users in-game skills or abilities. Picture an NPC master training a user in virtual martial arts at a martial arts dojo.
  - 5. Emotional Interaction:** Advanced AI-equipped NPCs emotionally react to users' actions. In a social simulation metaverse, envision an NPC smiling at a user's kind behavior or getting angry at rude actions.

# 1. Quest Assignment Example – A scene where an NPC gives a user a task.



A player talks to an A.I. powered NPC resembling CEO David Evans

[https://medium.com/@TCG\\_World/empowering-the-tcg-world-metaverse-with-ai-powered-npcs-8a04f298f5fd](https://medium.com/@TCG_World/empowering-the-tcg-world-metaverse-with-ai-powered-npcs-8a04f298f5fd)

## 2. Shop Transaction Example – A scene where an NPC merchant and a user trade items.



Shopping in the Metaverse Could Be More Fun Than You Think - CNET

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<https://www.google.com/imgres?q=metaverse%20virtual%20shop%20NPC&imgurl=https%3A%2F%2Fwww.cnet.com%2Fa%2Fimg%2Fresize%2F433f6291be01067c9bf89172e086321285694354%2Fhub%2F2022%2F03%2F17%2Fce6d7c42-e845-46cc-929b-d257334235e0%2Fshopping-hero-main-2000x1000.jpg%3Fauto%3Dwebp%26fit%3Dcrop%26height%3D675%26width%3D1200&imgrefurl=https%3A%2F%2Fwww.cnet.com%2Ftech%2Fcomputing%2Ffeatures%2Fshopping-in-the-metaverse-could-be-more-fun-than-you-think%2F&docid=zhVg1EMzzLggSM&tbnid=pFmMjUiLJRVESM&vet=12ahUKEwi6sdbkmNWHAXVAja8BHdk8NkgQM3oECFwQAA..i&w=1200&h=675&hcb=2&ved=2ahUKEwi6sdbkmNWHAXVAja8BHdk8NkgQM3oECFwQAA>

### 3. Conversation and Information Provision

Example – A scene where an NPC talks to a user and provides information

SOFTWARE | 29.05.2023

#### **Nvidia unveils new AI products — including tool for making better NPC dialogue**

*By Bloomberg*



<https://mybroadband.co.za/news/software/493625-nvidia-unveils-new-ai-products-including-tool-for-making-better-npc-dialogue.html>

## 4. Education and Training Example – A scene where an NPC teaches a user a skill.

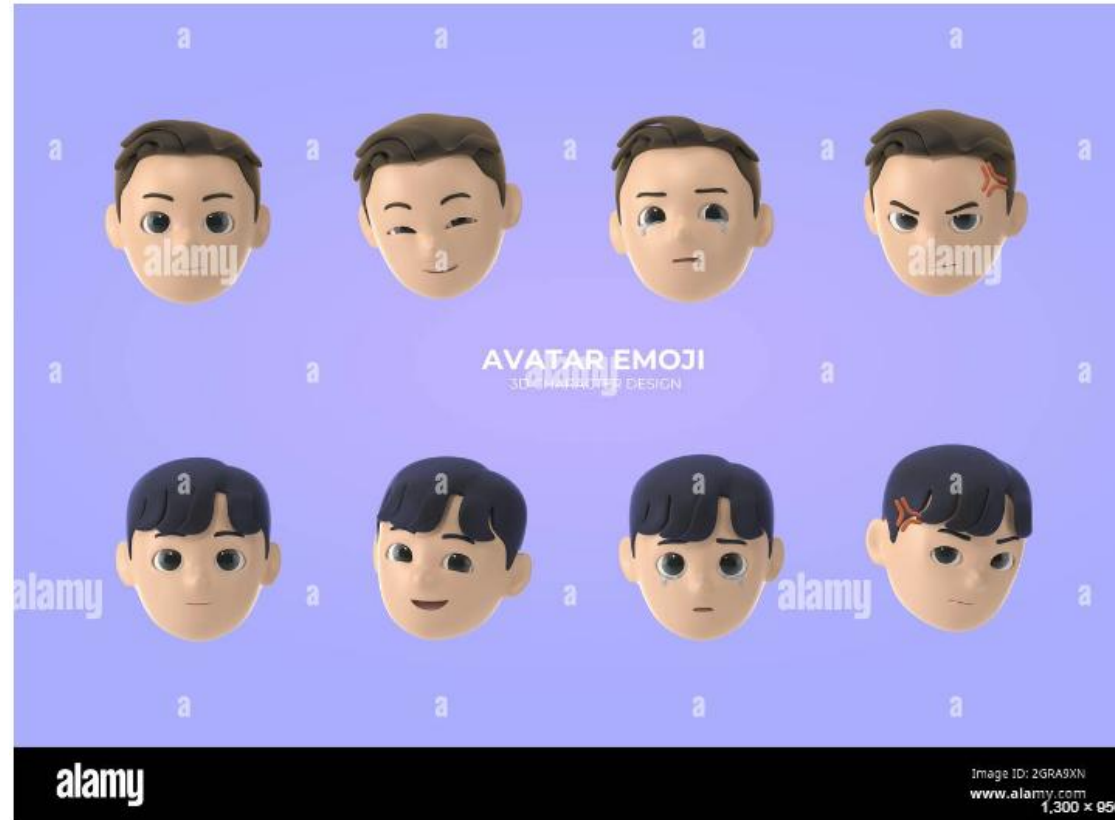


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[https://www.google.com/imgres?q=metaverse%20NPC%20emotional%20response&imgurl=https%3A%2F%2Fc8.alamy.com%2Fcomp%2F2GRA9XN%2F3d-rendered-avatar-man-character-with-emotions-in-metaverse-virtual-reality-2GRA9XN.jpg&imgrefurl=https%3A%2F%2Fwww.alamy.com%2F3d-rendered-avatar-man-character-with-emotions-in-metaverse-virtual-reality-image444623613.html&docid=fD2P7Ds8I\\_5eEM&tbnid=roj4nKSqNRHGrM&vet=12ahUKEwizleednNWHAX4bPUHHRjFCwE4ChAzegQIYRAA..i&w=1300&h=956&hcb=2&ved=2ahUKEwizleednNWHAX4bPUHHRjFCwE4ChAzegQIYRAA](https://www.google.com/imgres?q=metaverse%20NPC%20emotional%20response&imgurl=https%3A%2F%2Fc8.alamy.com%2Fcomp%2F2GRA9XN%2F3d-rendered-avatar-man-character-with-emotions-in-metaverse-virtual-reality-2GRA9XN.jpg&imgrefurl=https%3A%2F%2Fwww.alamy.com%2F3d-rendered-avatar-man-character-with-emotions-in-metaverse-virtual-reality-image444623613.html&docid=fD2P7Ds8I_5eEM&tbnid=roj4nKSqNRHGrM&vet=12ahUKEwizleednNWHAX4bPUHHRjFCwE4ChAzegQIYRAA..i&w=1300&h=956&hcb=2&ved=2ahUKEwizleednNWHAX4bPUHHRjFCwE4ChAzegQIYRAA)

## 5. Emotional Interaction Example – A scene where an NPC emotionally reacts to a user's actions.



3D rendered avatar man character with emotions in metaverse ...

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# Metaverse System Examples

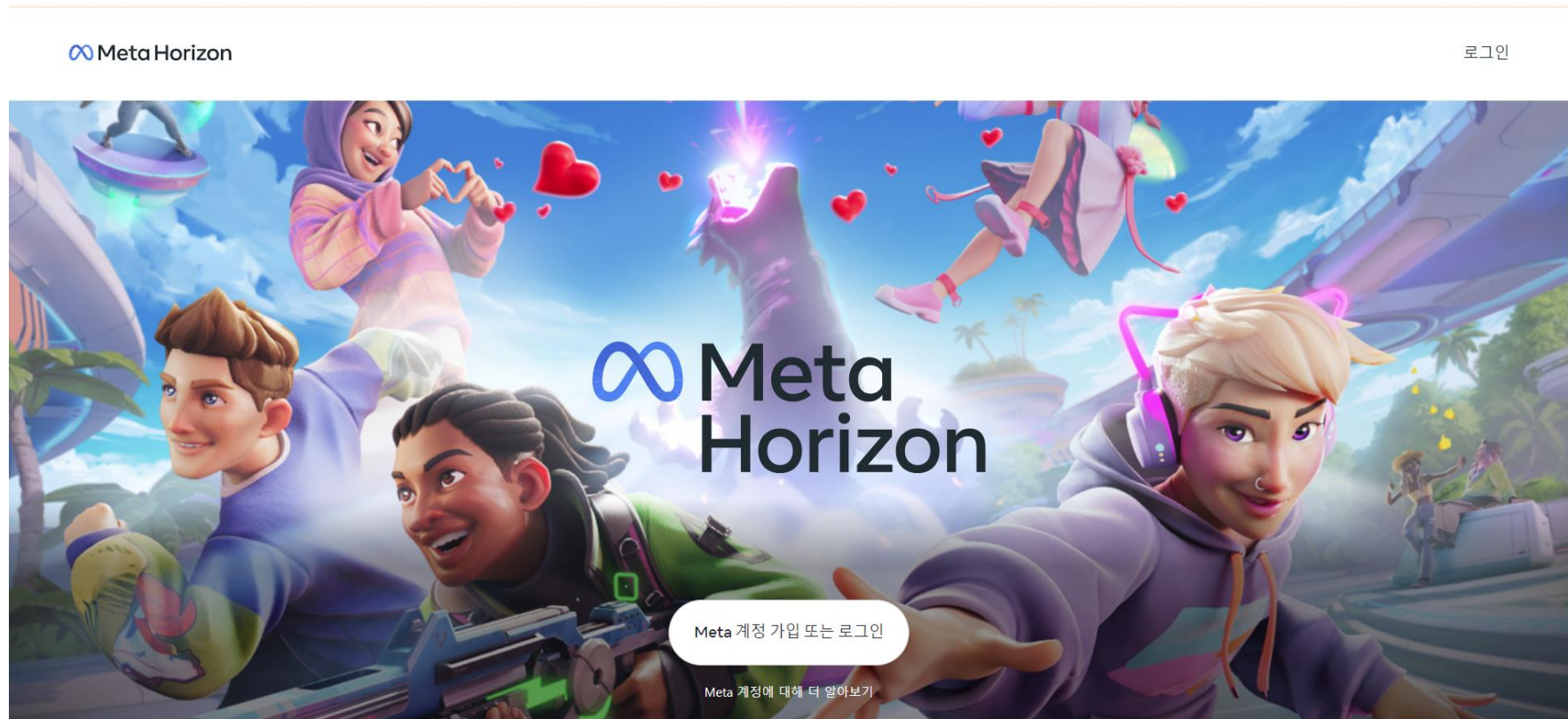
# IMVU

- IMVU is a 3D avatar-based social networking platform launched in 2004, which can be seen as an early form of a metaverse system.
- IMVU is an early form of a metaverse system, providing a platform where users can express themselves, interact with others, and experience a variety of activities in a virtual world. Through elements such as social networking, customization, economic systems, and user-generated content, IMVU showcases the potential of the metaverse.



# Meta Horizon

- Meta Horizon Worlds is an online virtual reality game with an integrated game creation system developed and published by Meta Platforms.
- On this multi-player virtual platform, players move and interact with each other in various worlds that host events, games, and social activities.



# Roblox

- Roblox is a notable example of a metaverse system, allowing users to experience various activities in a virtual world.
- Roblox is a platform that realizes the concept of the metaverse through diverse user experiences, social interactions, economic systems, and user-driven content creation. These elements provide an environment where users can transcend the boundaries between reality and virtuality, communicating, creating, and enjoying in new ways.



# Second Life

- “Second Life” is a virtual world developed by Linden Lab (a San Francisco–based firm) in 2003 and is considered one of the early forms of the metaverse.
- In 2013 it had approximately one million regular users. By the end of 2017 the active user count had declined to “between 800,000 and 900,000”.



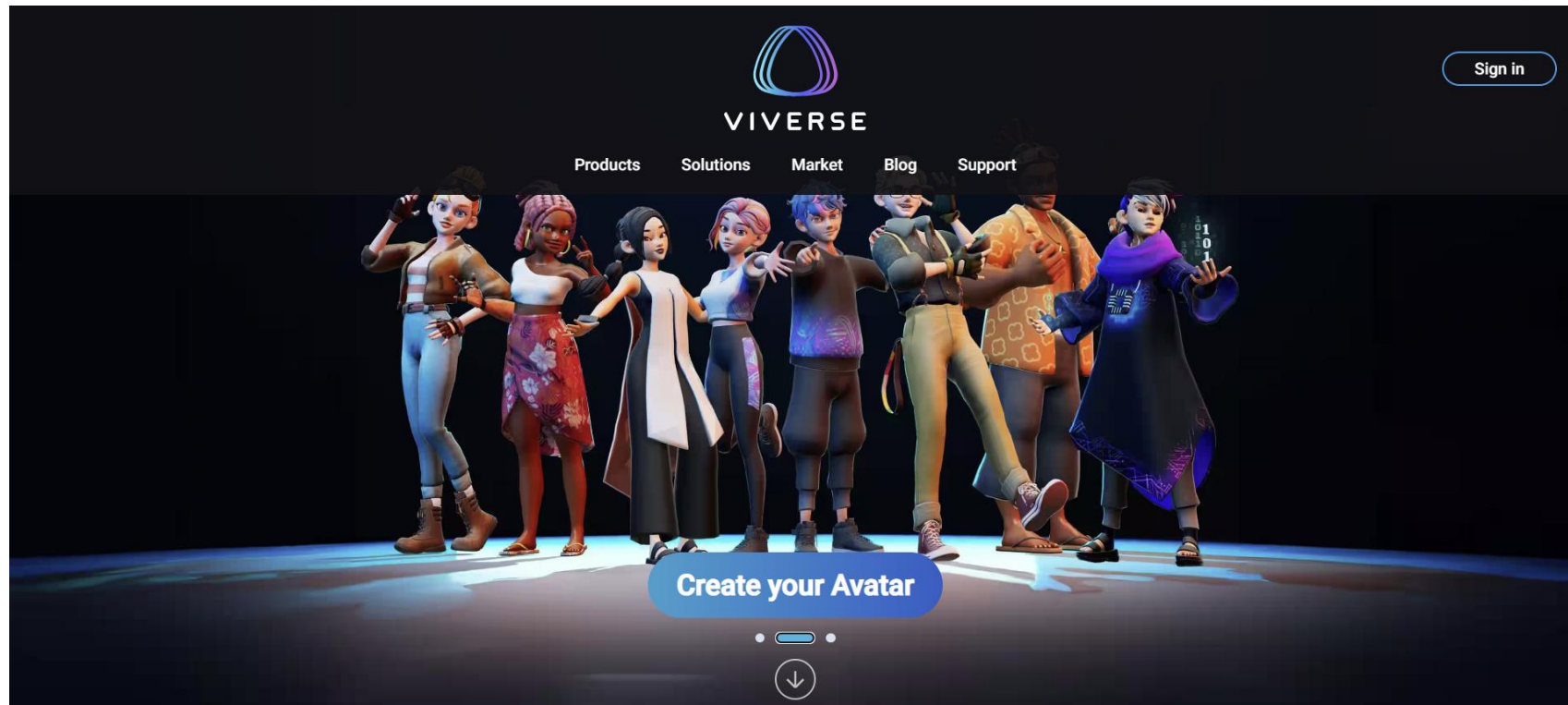
# SK Ifland

- SK Ifland is a metaverse platform provided by SK Telecom. It is open on 14 July, 2021
- Initially, SK Ifland has 18 Themes and 800 Avatars. As of 16 August 2023, more than 500,000 users has made IfHome in Ifland. Its monthly active users (MAU) in July 2023 is about 437,000 users.
- SK Ifland terminated its service on March 31, 2025.



# VIVERSE

- Viverse is an open platform for virtual worlds and environments developed by HTC and encompassing multiple devices and applications.
- Conceived as a metaverse, the platform is intended to create an interconnected series of virtual worlds, and includes elements of augmented reality.



# VRChat

- VRChat is a virtual reality social platform where users can interact within a metaverse environment.
- VRChat is a platform that implements several key elements of the metaverse, supporting creative and social experiences for users. This demonstrates that the metaverse goes beyond simple virtual reality and plays a crucial role in forming a new type of digital society.



# Common Key Features

- **Avatar Customization**: Users can create and customize their own avatars, providing a more personalized experience.
- **Virtual Spaces**: Various themed virtual spaces are available, allowing users to engage in activities in their preferred environments. For example, there are meeting rooms, concert halls, amusement parks, and more.
- **Social Features**: Metaverse system includes real-time communication and collaboration features, enabling users to meet friends or network with new people.
- **User-Generated Content (UGC)**: Metaverse system actively encourages user-generated content. Users can create and share their own items, virtual spaces, animations, and more with others. This is a crucial aspect that enhances creativity and diversity within the platform.
- **Events and Activities**: Metaverse system supports a variety of events and activities to keep users engaged. For instance, concerts, exhibitions, and workshops can be held within the virtual space.
- **Business Applications**: Companies can also utilize metaverse system for virtual meetings, product launches, training sessions, and more. This enables global collaboration beyond physical limitations.
- **Economic System**: Metaverse system has a virtual economy system. Users can purchase avatar items, virtual spaces, and services using virtual currency. Additionally, users can design and sell their own items to generate revenue.

# Privacy Issues of Interaction in Metaverse

# Privacy in Metaverse

- Avatar Appearance and Customization Information
  - Avatar's physical appearance (face, hair, body shape, etc.)
  - Clothing, accessories, decorations, etc.
- User Profile Information
  - Username or nickname
  - User photo or avatar image
  - Basic personal details such as birthdate and gender
- Social Network Information
  - Friend list
  - Conversation and message history
  - Information about groups and communities the user is part of

# Privacy in Metaverse

- Activity and Behavior Records
  - Movement paths and places visited within the metaverse
  - Events and activities participated in
  - Information about interactions with other users
- User-Generated Content
  - Posts, photos, videos, etc.
  - Reviews and comments
- Economic Information
  - Virtual currency balance and transaction history
  - Virtual items and assets owned
- Other Personal Settings
  - User preferences and interests
  - Personalized settings (notifications, privacy settings, etc.)

# Privacy protection techniques in Metaverse platforms

Source: Avatar Privacy Challenges in the Metaverse: A Comprehensive Review and Future Directions

Somaya Eltanbouly, Osama Halabi & Junaid Qadir

Qatar University



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# Avatar Privacy Challenges in the Metaverse: A Comprehensive Review and Future Directions

Somaya Eltanbouly  , Osama Halabi & Junaid Qadir

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 <https://doi.org/10.1080/10447318.2024.2374091>



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## Abstract

The concept of the Metaverse has sparked great interest as a futuristic virtual space that provides immersive experiences and social interactions through digital avatars. However, using avatars in the Metaverse raises privacy concerns that require innovative solutions to ensure the safety of users. In

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# What are the privacy techniques of the avatars proposed in the literature?

- In response to the privacy issues of avatars in the Metaverse, researchers have recently begun exploring potential solutions to mitigate these issues and minimize the risks associated with private information disclosure.
- In this section, we will discuss the proposed solutions suggested by the researchers to create a safe Metaverse.

# Summary of the privacy defenses proposed for identity-related threats

Paper	Year	Main issue	Privacy defense	Limitations
Wang et al. (2021)	2021	User identification	Blurring the user's avatar	Having a blurred avatar decreases the user's presence in the virtual world
Nair et al. (2022a)	2022	User identification	Providing incognito mode to the users	It did not include any safety options to lower the face details accuracy. It depends fully on user awareness.
Yao et al. (2021)	2021	User identification	Providing incognito mode to the users	Only a few data can be adjusted, which are eye tracking and the background. It depends fully on user awareness
Zelenyanszki et al. (2023)	2023	Avatar cloning and behavior copying	Detecting cloning by comparing avatars	The current implementation is just comparing the avatar images. Thus, cloning may be detected if two users use a publicly available avatar.

Table 4 of “Avatar Privacy Challenges in the Metaverse: A Comprehensive Review and Future Directions”

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- Nair, V., Garrido, G. M., Song, D. (2022a). Exploring the unprecedented privacy risks of the metaverse (p. 7). <http://arxiv.org/abs/2207.13176>
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- Yao, P., Lympouridis, V., & Zyda, M. (2021, March). Virtual equipment system: Face mask and voodoo doll for user privacy and self-expression options in virtual reality [Paper presentation]. 2021 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), Lisbon, Portugal (pp. 747–748). <https://doi.org/10.1109/VRW52623.2021.00256>
- Zelenyanszki, D., Hou, Z., Biswas, K., & Muthukkumarasamy, V. (2023). A privacy awareness framework for NFT avatars in the metaverse [Paper presentation]. 2023 International Conference on Computing, Networking and Communications (ICNC), Honolulu, HI (pp. 431–435). <https://doi.org/10.1109/ICNC57223.2023.10074107>

# Suggested solutions to the social issues

- The issue of harassment in social VR has been discussed several times before, either by researchers' users' studies or in incidents reported on social VR platforms.
- Many users have witnessed such incidents while existing in the virtual worlds.
- Therefore, researchers proposed different ideas to mitigate such issues.

# Summary of the privacy defenses proposed for the social threats

Paper	Year	Main issue	Privacy defense	Limitations
Wolf et al. (2022)	2022	Interactions with strangers	Controlling the transparency of other avatars	Seeing transparent people is unrealistic in the real world. Thus, it decreases the user’s presence.
Schulenberg, Li, et al. (2023)	2023	Harassments	Detecting harassment through AI moderator	The solution is not yet implemented. Also, users raised some concerns about AI generalizability.
Fiani et al. (2023, 2024)	2023, 2024	Harassments	Detecting harassment and bullying through AI moderator	Only a prototype was provided.

Table 5 of “Avatar Privacy Challenges in the Metaverse: A Comprehensive Review and Future Directions”

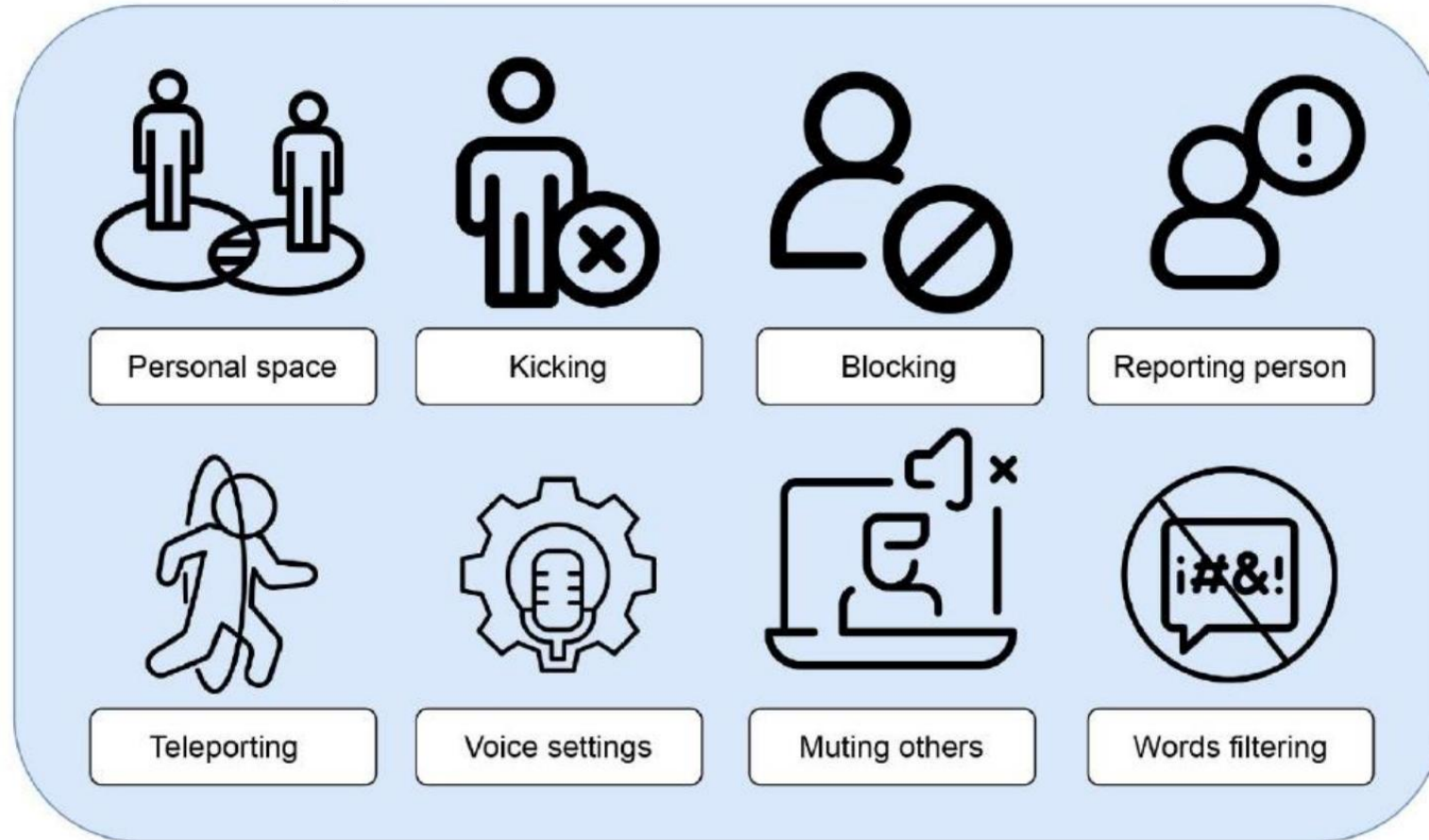
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<https://doi.org/10.1145/3613904.3642144>
- Schulenberg, K., Freeman, G., Li, L., & Barwulor, C. (2023). "Creepy towards my avatar body, creepy towards my body": How women experience and manage harassment risks in social virtual reality. Proceedings of the ACM on Human-Computer Interaction, 7(CSCW2), 1–29. <https://doi.org/10.1145/3610027>
- Wolf, A. E. M., Reinhardt, J., Kurzweg, M., & Wolf, K. (2022, March 13). SocialSlider: Changing the transparency of avatars [Paper presentation]. AHs 2022: Augmented Humans 2022, Kashiwa, Chiba, Japan (pp. 276–283).  
<https://doi.org/10.1145/3519391.3519392>

# What privacy options are available in the social VR platforms?

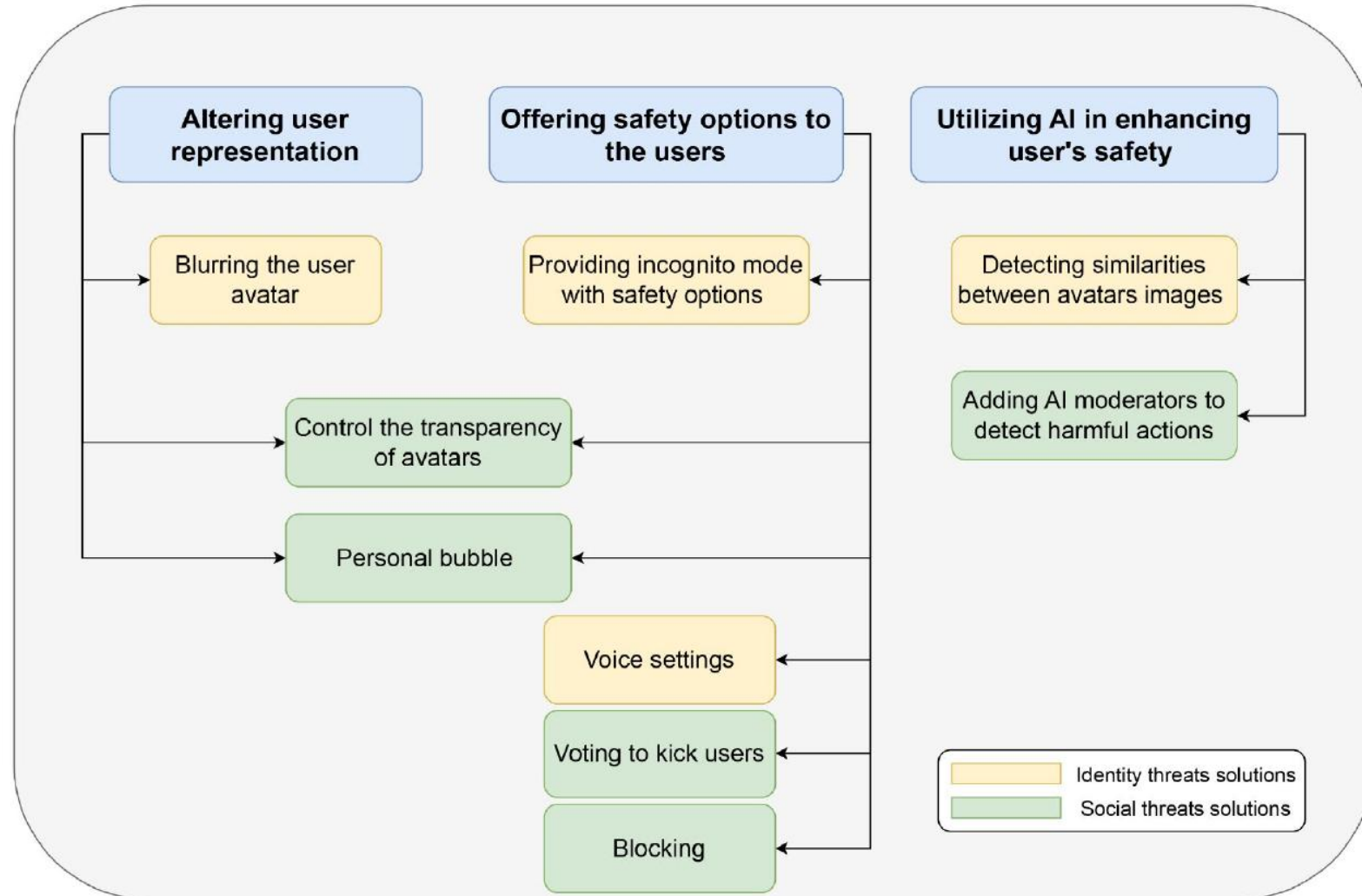
- Social VR and Metaverse platforms like Meta Horizon, VIVERSE, VRchat, etc., are considering various privacy techniques to protect their users' privacy.
- Many platforms use techniques like providing personal space or muting and blocking options.

# The safety control options social VR platforms provide

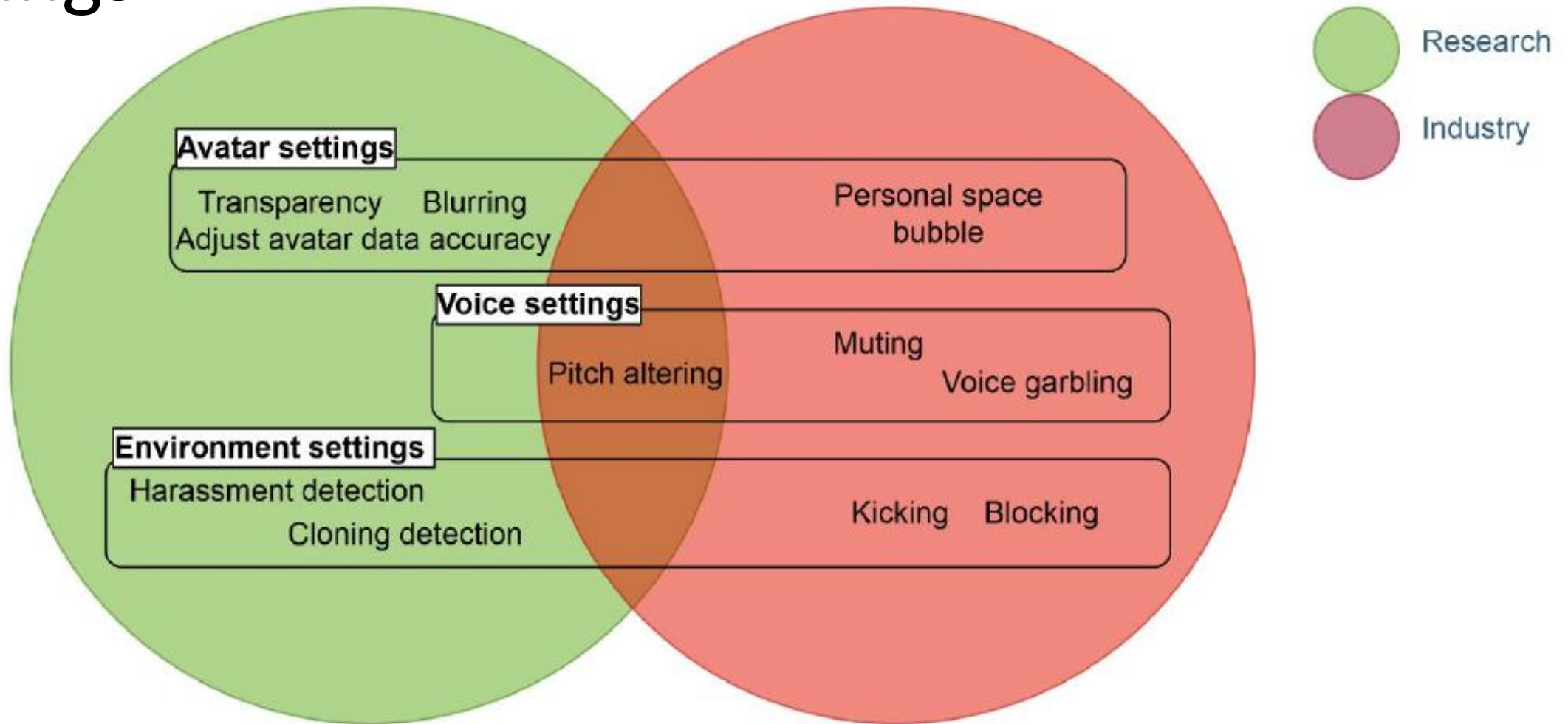


Eltanbouly, S., Halabi, O., & Qadir, J. E. (2024). Avatar Privacy Challenges in the Metaverse: A Comprehensive Review and Future Directions. *International Journal of Human-Computer Interaction*. July 2024.  
<https://doi.org/10.1080/10447318.2024.2374091>

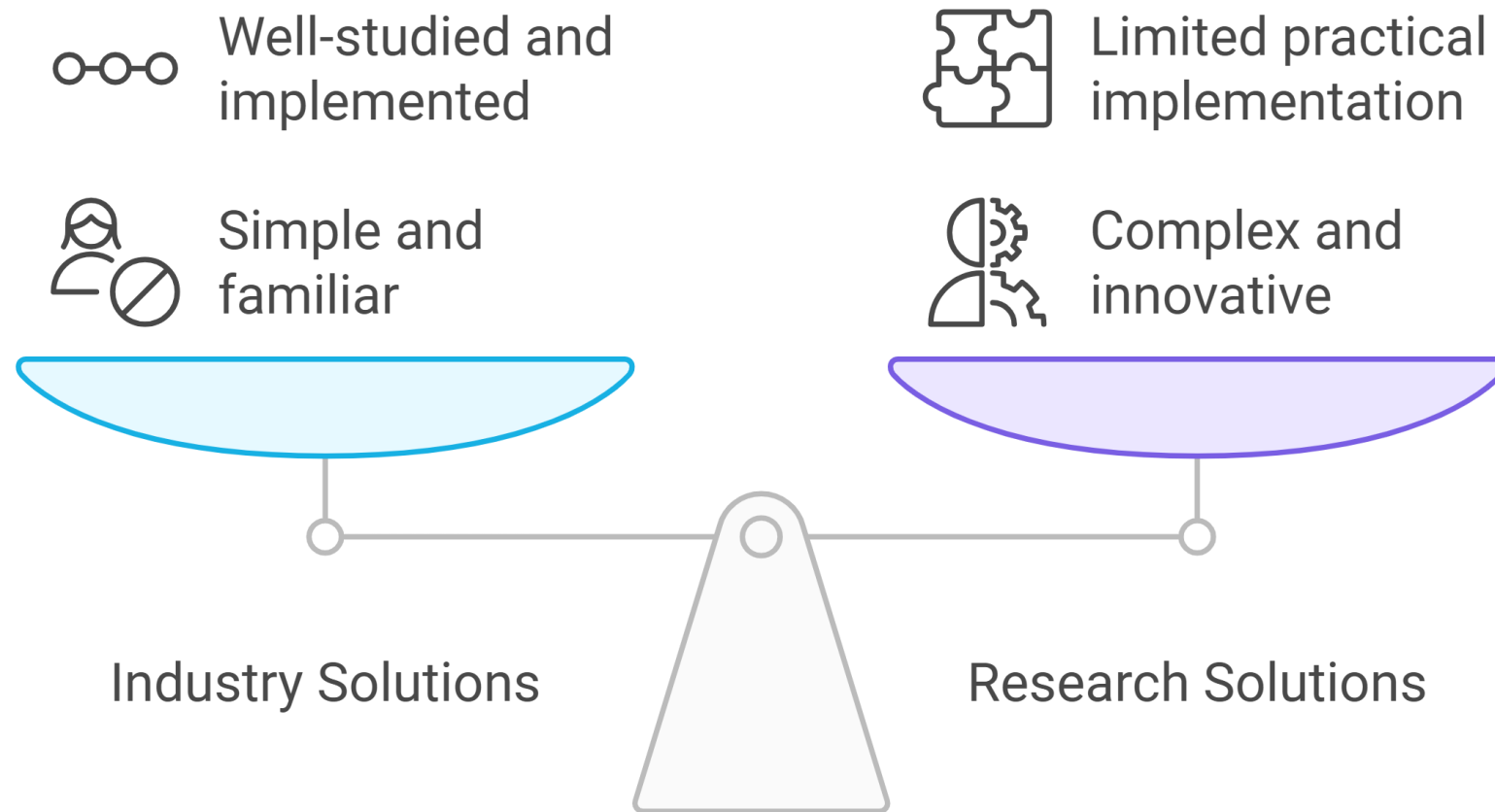
# The most used privacy techniques provided by the most popular VR platforms



# Differences between industry and research privacy settings

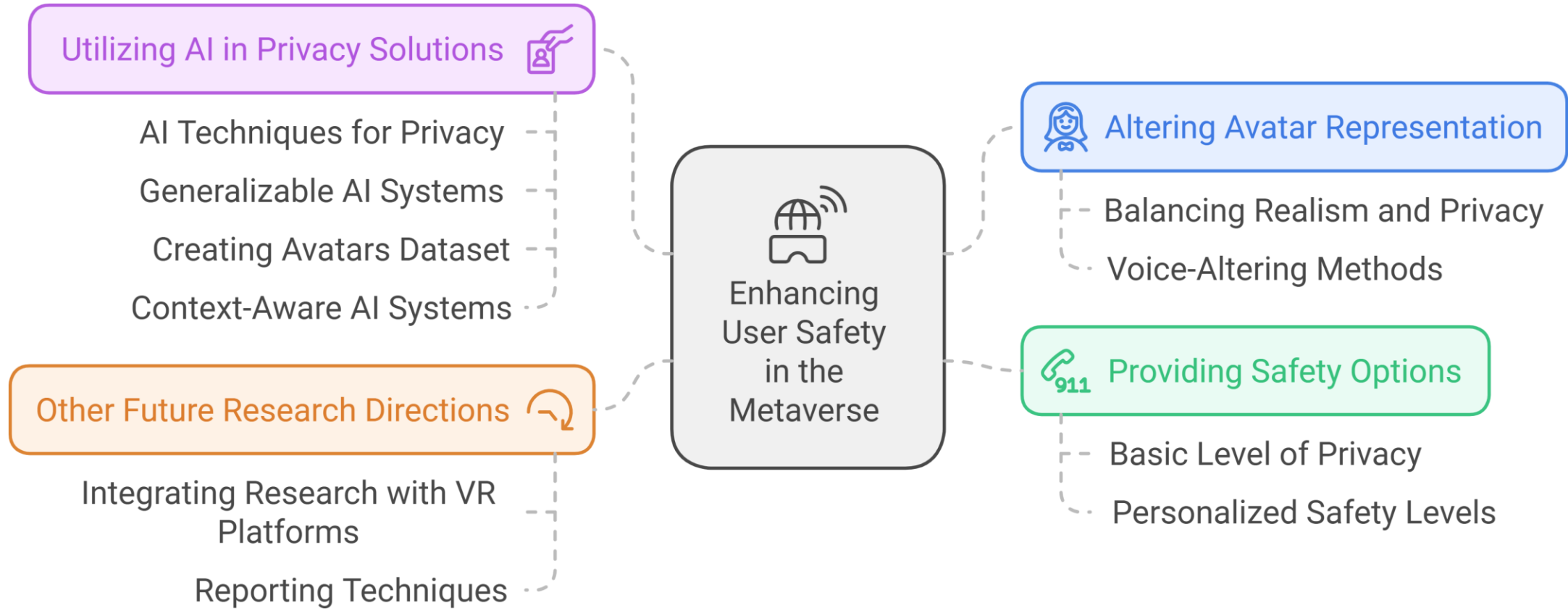


# Balancing industry and research solutions for avatar safety in the Metaverse



Balancing industry and research solutions for avatar safety in the Metaverse.

# Future Research Directions



# That's all, thanks!

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