Action-Based Audit with Relational Rules to Avatar Interactions for Metaverse Ethics

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Abstract

Metaverse provides a simulated environment where a large number of users can participate in various activities. In order for Metaverse to be sustainable, it is necessary to study ethics that can be applied to a Metaverse service platform. In this paper, Metaverse ethics and the rules for applying to the platform are explored. And, in order to judge the ethicality of avatar actions in social Metaverse, the identity, interaction, and relationship of an avatar are investigated. Then, an action-based audit approach to avatar interactions (e.g., dialogues, gestures, facial expressions) is introduced in two cases that an avatar enters a digital world and that an avatar requests the auditing to subjects, e.g., avatars controlled by human users, artificial intelligence (AI) avatars (e.g., as conversational bots), and virtual objects. Pseudocodes for performing the two cases in a system are presented and they are examined based on the description of the avatars' actions.

Keywords : Metaverse | avatar interaction | action-based audit | relational rule | Metaverse Ethics

I. INTRODUCTION

Metaverse is a simulated environment in which human users can interact with computer-generated objects and other users. The Metaverse is different from virtual reality (VR) and augmented reality (AR) in terms of service sustainability, immersive experience, and scalability [1]. In Metaverse, users create social, cultural, and economic values with connecting the virtual and real worlds. An avatar is one of key components for Metaverse. An avatar is a character object that plays the role of an arbitrary subject (e.g., a human user). It depicts a subject with graphical representation in the form of two- or three-dimension (2D/3D) [2]. A human user projects himself/herself on an avatar and interacts in a digital space with various actions (e.g., through dialogues, gestures, facial expressions) [3].

Avatars controlled by users interact with human avatars, AI avatars, and virtual objects in a Metaverse world. Some interactions of the avatars may cause discomfort or inconvenience to other users. For Metaverse to be sustainable, avatar interactions need to be automatically audited.

In Section II, Metaverse ethics and the rules for applying to a system are explored. In Section III, in order to judge the ethicality of avatar actions in social Metaverse, the identity, interaction, and

Table 1. Comparison of Metaverse ethics, AI ethics, and robot ethics [4]

Items	Metaverse Ethics	AI Ethics	Robot Ethics
Target Relationship	• Complex relation with one or more subjects (e.g., human user, AI avatar, virtual objects)	• Relation between a human user and an AI system(s)	• Relationship between a human user and a robot(s)
Target Type	• Avatars controlled by human users • AI avatars • Digital objects in the virtual and real worlds • Real objects associated with digital objects	• Mostly, real objects • Digital objects, as AI is utilized in Metaverse	• Real objects, in the scope of robot applications
Space for Activities	• A 3D/2D virtual space • A virtual space superimposed on the real world	• In a real space • Extension to a virtual space, as AI is utilized in Metaverse	• In a real space
Economic System	• An economic system in a virtual world, which could be connected to the real world • An economic system in which digital objects and the values of experiences/activities can also be traded	• An economic system in the real world	• A real−world economic system (but, limited)
Rationale for Designing Ethical Guidelines	• Focusing on the impact of services and technologies on individuals and societies in various metaverse worlds as well as in the real world	• Focusing on the impact of service and technology on individuals and society	• Focusing on relationships and tasks with robots
Scope of Development of Ethical Guidelines	• For everyone (e.g., users, creators, developers, operators) • Development of ethical guidelines that can be reflected in the system (i.e., programmable ethics)	• In the user−centered perspective for AI services	• In the user−centered perspective for robot services
Safety & Responsibility	• In both the virtual and real worlds • Responsible for users (i.e., players), creators, developers, and operators	• In the real world (based on AI technology impact assessment) • Responsible for developers and operators	• In the real world (e.g., human protection, maximization of work efficiency) • Responsible for developers and operators
UX Design	• Based on values pursued in Metaverse worlds (with considering not only economic, but also psychological satisfaction according to social and cultural activities)	• Based on the purposes and effects (especially, economy) of services	• Based on the relationship (e.g., for human safety) with robots

relationship of an avatar are investigated. In Section IV, an action−based audit approach to avatar interactions (e.g., dialogues, gestures, facial expressions) is introduced and examined based on the description of the avatars' actions. Section V concludes this paper.

II. SOCIAL METAVERSE WITH ETHICS

In Metaverse, a large number of users enjoy various social activities [5]. In social Metaverse, when a user enters a digital world with an independent worldview or establishes new relationships with other users, ethical rules for a Metaverse world are necessary [6].

A. Metaverse Ethics

For designing the ethical guidelines for a digital society, comparison of Metaverse ethics, AI ethics, and robot ethics is presented in Table. 1. Metaverse ethics have much wider and complex conceptual structure that is different from AI ethics and robot ethics. In robot ethics, ethical principles are explained with a focus on the relationship with humans. AI ethics explain the principles for increasing the trust and reliability to an intelligent service system, such as transparency, explainability, fairness, and accountability. Metaverse ethics are recently considered as a software infrastructure that should be applied to a service platform (e.g., Roblox, Minecraft, Zepeto). Metaverse ethics are very complex to explain, as they allow users to be players, creators, developers, and operators, with different relationships in a Metaverse world [4]. This is because creative activities are possible in an open platform architecture with a high degree of freedom of users. The guidelines and rules for Metaverse ethics can be designed by interpreting avatar interactions in a Metaverse world.

1) Immersive Experiences: Metaverse tries to provide an immersive experience to users in a 3D simulation environment, but the technology for implementing a Metaverse service platform is still in the growth stage. As such, some technologies for providing immersive experiences may have a negative impact on individuals and society. Studies on Metaverse ethics are needed along with discussions on the scope and methods for users' immersive experience. Some communities have already started user-centered practical discussions [7], [8].

2) Society: Advances in technology for immersive virtual environments have led to the evolution of digital games into complex social worlds in which people play collaboratively or cooperatively to achieve individual- and group-oriented goals [9]. In Metaverse, new values can be created in a social context. For social activities under social and cultural norms, identification of avatar identity is required first [10]. In Metaverse, the various roles of users create social relationships with other users, AI avatars, and virtual objects. Rules for security and safety in the digital society need be established. In Metaverse, individuals and groups should be able to engage in various types of activities to reconcile conflicts.

3) Privacy and Security: Privacy to the use of personal data is a bigger issue in Metaverse than that of the real world. This is because it is easy to track data in the digital space. Users unfamiliar with technology may find it difficult to recognize that personal data is being collected (e.g., with recording speeches and dialogues)[11]. Without user's awareness, auditing to the user may take place in an unexpected way [12]. Security to the services increases the satisfaction of user experience and the marketing value of a Metaverse platform. This encourages user participation in the services.

In order to classify a user's personal data, data confidentiality, data integrity,

and data reliability should be evaluated by analyzing the characteristics of data and a device generating the data [13]. This should be extended to classify the personal data, including data generated from user actions in the Metaverse.

B. Design of Rules for Metaverse Ethics

Research interests to Metaverse have focused on the technologies for platforms, so there are not many studies on Metaverse ethics. In order for Metaverse to exist as a sustainable digital society, it is necessary to study Metaverse ethics that can reflect the values of the communities pursued by human society [6, 14]. Along with the development of Metaverse platforms, it is necessary to examine the proposed rules for Metaverse ethics and methods by which these rules could be systematically implemented.

1) Consideration of Multiple Metaverse Worlds: Metaverse can have multiple virtual worlds. Each Metaverse world has an independent worldview, which means that it can have independent ethical rules. In other words, it tells us that the same action of an avatar can receive different ethical evaluation according to the rule of an individual Metaverse world. For multiple virtual worlds, multiple ethical rules must be applied to users in a priority order.

2) Consideration of the Range of Avatar's Actions: In Metaverse, an avatar controlled by a human user may have a limited range of actions. The action is expressed by voice, text, gesture, and the like. The avatar may not have the same range of actions for the interaction as that of other avatars. The range of avatar actions is limited by a Metaverse platform accessed by a user, a Metaverse world system, interaction devices, or user's physical disability. When avatars' actions vary in range, it is complex to apply multiple rules for Metaverse ethics to users who interact with each other.

3) Consideration of Interaction with AI Avatar: People who access a Metaverse world want new digital experiences. To share such experiences, tools for authoring and operating Metaverse services are needed. AI technology can be used to develop various types of tools to build Metaverse environments, produce services, and support user activities [15]. In addition, AI technology can be used for AI avatars to improve user experiences for various services [16]. AI avatars (e.g., as conversational bots) can provide information to users or make recommendations for decision-making. As the technology for dialogue state tracking (DST) has developed, the conversational level of AI avatars will also increase. This means that AI avatars equipped with low-level conversational engines (e.g., chatbot or voice-bot engine) can raise a number of ethical issues in conversations. In a 3D simulated environment, AI avatars participate in services for users and interact with human avatars controlled by users. In Metaverse, users can produce greater values through collaboration with AI, so it is essential to consider this.

When users' avatars capable of predefined actions interact with AI avatars, unexpected ethical problems may arise because the decision-making of an avatar, which can only perform limited actions, is not properly communicated with the AI avatar.

C. Challenges for Programmatic Ethics

The guidelines for Metaverse ethics have studied and developed, but they need to be applied as rules to a system in the *programmable form for automated audit*. In Metaverse, which seeks to support free creative activities, users can be players, creators, developers, and operators. For this reason, ethical rules for Metaverse should be designed considering into account various situations and roles.

Users engage in social activities and establish relationships on the Metaverse providing a three-dimension simulated environment. Users access a digital world with their avatars and receive services through various interactions. Metaverse is more user-centric than other service platforms.

Metaverse that constitutes a sustainable digital society has scalability. The metaverse worldview can change according to the social values of users and groups, which means that ethical rules must also be continuously updated.

III. METAVERSE AVATAR

An avatar is one way to express identity in Metaverse. A user can create his/her avatar by depicting it realistically or abstractly. A realistic avatar is created with reflecting various characteristics of human appearance. Software such as Meta-human Creator can create human-like avatars, but it can be used on Metaverse platforms that supports the use of externally created avatars. The realistic avatar can be expressed as a two- or three-dimension avatar. A 2D avatar is commonly used in the 2D environment. A 3D avatar is more human-like, and can express hair, skin color, etc. In Metaverse, the avatar can be customized by the human user at any time. An abstract avatar is created by leaving or emphasizing only the main characteristics of a fully described avatar, for example, without legs or a simpler form to express the user.

A. Identity

Identity is the sum of all parts represented by the appearance, behavior, attitudes, and characteristics that makes up a specific subject (e.g., a human user) [17]. Identity mentioned in Goffman's media theory is to selectively depict or beautify some parts of a human user so that the complemented appearance can be used in a digital space such as the Internet[18].

For a human avatar, it should be possible to use a Metaverse service by changing the appearance of hair, skin color, height, etc. It is possible to pass all criteria for identifying person's characteristics in the real world, such as face color, the shape of the eyes, the color of the pupils, the color of hair, the shape and the presence or absence of wrinkles, in the creation of

an avatar, and to construct an avatar of a newly combined self for use in the virtual world. The *visual identity* method is not perfect, like the abstraction felt when looking at many similar Internet IDs[19]. The appearance of the avatar helps to identify for a limited time in a Metaverse world, so more fundamental identification methods are needed. The avatar identity needs to be unique in Metaverse, except for the special purpose. While moving among Metaverse worlds, the appearance of the avatar may change, but its identity must remain connected. This is called as a *continuous identity strategy*[18]. Economic, social, and cultural activities using avatars can be made more freely with their identities. In a situation where the identity of the avatar is guaranteed, the avatar itself may have economic value.

In a Metaverse world, there may not be a one-to-one relationship between a human user and an avatar. One human user may own multiple avatars, and multiple human users may own one avatar. This is equivalent to one human user owning multiple identities on the Internet.

In accordance with the social nature of Metaverse, users also can share personal information with Metaverse participants (whether close friends or a large number of unspecified people). Unlike the existing internet, the more personal information is exposed in Metaverse, the more immersive experience is possible. Nevertheless, many Metaverse platforms still place responsibility for personal data-related privacy issues on individuals. Privacy is an issue that needs to be addressed along with avatar identification,
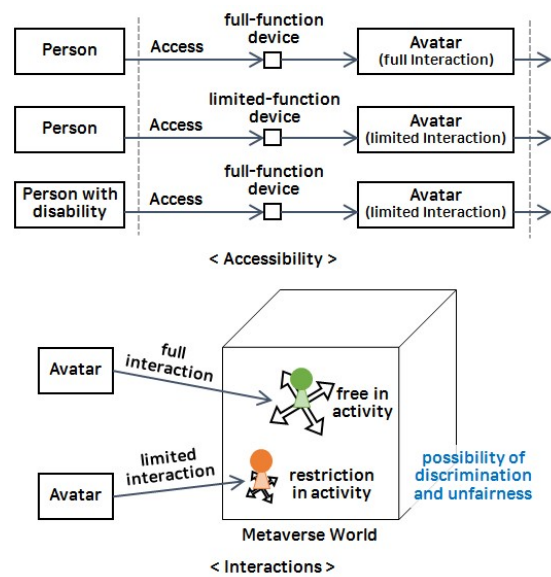

Fig. 1. Description of inclusive interaction

as more data is linked with avatar identification. If the identity of a user is stolen in Metaverse, avatars, digital assets, social relationships, and even the digital life can be leaked and lost, which can be more severe than those of conventional service platforms [20].

B. Interaction

The basic idea of a massively multiplayer online game (MMOG) was to create a virtual world with as many life-like characteristics as possible. In multiplayer games, players engage in social interactions both inside and outside the game[21]. Most multiplayer games give the player an avatar to control. In general, an avatar is considered to be a representation of the user in the game world.

Through avatars in a Metaverse world, human users can perform various actions that they could not do in the real world. Although interactions may be technically limited, the combined behaviors of avatar

interactions may differ from reality [22]. The counterpart users of the interaction can be 1: infinity.

In MMOGs, users engage in group play with activities that include collaboration (e.g., making friends within the game context), community (e.g., guild, clan), and social interaction [23,24]. Most MMOGs encourage collective play and other forms of social interaction among gamers[25]. Metaverse has the characteristics (i.e., social activities) of an MMOG, but Metaverse enables simulation-based creative activities and is more complex and closely intertwined with the real world. The Metaverse is a *hyper-connected* digital space and a *hyper-personalized* digital space.

1) Inclusive Interaction: For extended reality (XR), people with disabilities may not have been taken into account in applications for immersive experiences [6, 26]. For example, if a game requires full-body movement in an XR suit, a lower-body disabled person may need other control assistance to move. Groups such as the W3C Immersive Captions Community Group[7] and XR Access Initiative[8] are discussing these. If unexpected actions lead to undesirable consequences, service providers should be able to attempt to fix newly discovered bugs on the platform or alert users who violate the rules for a digital society[27].

The rules for Metaverse ethics need to be reflected so that there is no such damage in digital society[28]. Restriction of avatar activities may be caused by a human user's physical disability or the use of a device with limited functions (i.e.,
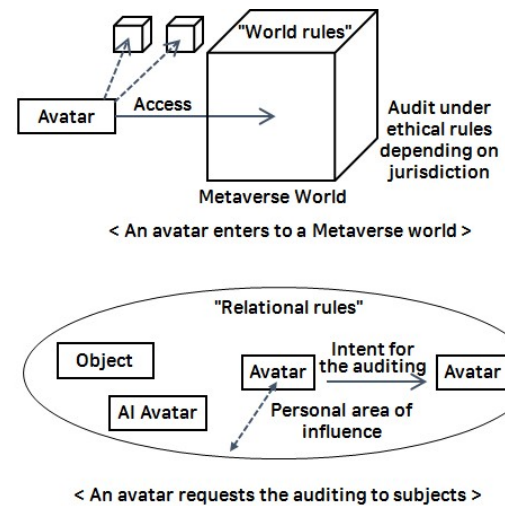

Fig. 2. Avatar audits for two cases of the access and request

by devices with the low-cost) as shown in the Fig. 1. For example, the data glove may be manufactured using various sensing methods[29]. The data glove may have similar sensing functions for large motions, but the manufacturing cost will increase to support detailed motions. For users who use low-cost interactive equipment, the use of equipment with limited functions causes inequality in other aspects.

C. Relation

Relation is an existing connection or a significant association between or among things. *Relational rules* refer to the tendency of people (i.e., avatars herein) in relationships to develop rules which are unique to the situations for specific interactions and to repeat them until they become reflected in patterns of behavior (i.e., actions)[30].

1) Relations with Human Avatars: An avatar controlled by a human user can

establish relationships with other human avatars. Intentional or unintentional relationship between a human avatar and another human avatar can be established in a Metaverse world, and even for the same interactions, different evaluation of auditing the interactions is made depending on the relationship.

2) Relations with AI Avatars and Virtual Objects: Through avatars, users can have relationships with AI Avatars and various objects in Metaverse worlds. In some situations, AI avatars taking programmed actions (e.g., speech, facial expression, appearance, conversation, behavior) for active and passive responses could be offensive to avatars controlled by users.

AI avatars can be set to autonomously evolve through learning. The AI avatars can imitate the actions of avatars in Metaverse worlds. If rules in the ethical perspective are applied to AI learning, then AI avatars can react in the ethical patterns which are programmed.

Ⅳ. Avatar Auditing in Metaverse

There is a study in which a player's skill action in a game is measured (as action-costs) and used for the game-play analysis[31]. Analysis of player actions can be used for the purpose of balancing the game. In Metaverse, avatar's actions can be evaluated against the rules for Metaverse ethics in order to judge unethical behaviors.

A. Audit to Avatar Interactions

1) Enforcement of Rules for Metaverse ethics: A Metaverse world has characteristics similar to a MMOG. Each game applies rules appropriate to the game context throughout gameplays (e.g., earning the highest point, trading items, team-play). Metaverse has various virtual worlds, and a virtual world may have independent rules. Gameplayers act with a specific purpose in the game world. Metaverse is a hyper-connected and hyper-personalized virtual world. As various values in a Metaverse world are pursued, each user's actions can have various meanings. Since various social activities in a Metaverse world are recommended more than games, it can be interpreted based on user's relationship. As social and personal values coexist in the real world, it is necessary to consider both world rules and relational rules in the metaverse. The rules for avatar interactions can be directly or indirectly enforced. For Metaverse, world rules and relational rules as shown in Fig. 2 need to be considered.

Basically, when an avatar entered one Metaverse world, it is affected by the ethical rules of that Metaverse world. At this time, under the highest ethical guidelines, the Metaverse ethical rules by the decision makers with jurisdiction is reflected in a Metaverse world and can be applied to the interactions of avatars.

On another case, users behind avatars sometimes may feel disgust, displeasure, etc., by the interactions of other subjects in a Metaverse world. More importantly, in this case, the scope of the subjects includes human avatars, AI avatars, and virtual objects that express functions

under specific conditions. Each avatar has a personal area of influence, and it can request the auditing to a specific target (i.e., a subject) which makes uncomfortable emotions (or, feelings). This can be seen as a kind of warnings. It is possible to prevent this situation from reoccurring, by auditing the interactions during a period of times or for an arbitrary period after this time.

2) Pseudocodes: Let $P_w(\psi)$ and $P_r(\psi)$ be sets of world rules and relational rules, respectively, where ψ is the index of a digital world. So, $P_w(\psi)$ (or $P_r(\psi)$) includes multiple rules such as p_0, p_1, ..., p_i, ..., p_n, where i is the index and n is the maximum number of rules. p_0 is the rule with the highest priority. p_i refers to an ethical rule in some situation or service scenario. For example, p_x may refer to the rule for office ethics, p_y may refer to the rule for sports ethics, and the like. Let $Q_w(\psi)$ and $Q_r(\psi)$ be sets of the priorities to world rules and relational rules, respectively. Since various rules exist in a digital world according to service contents and there may be conflicts among them, priority information of the rules is required. K is the information to external knowledge, e.g., a world environment, devices, disabilities, gender, and so on. Information about the underprivileged in a Metaverse world is helpful to protect users or avatars with disabilities. However, it is not covered in this section.

Let u_0 be an avatar that plays a role for a user. In Fig. 3, an approach to the auditing with world rules, AuditWithWR($P_w(\psi)$, $Q_w(\psi)$, K), is shown. Avatar interactions

of a user u_0 are audited. At line−01, $P_w(\psi)$ is updated with the priority information of $Q_w(\psi)$, by updateWorldRules($P_w(\psi)$, $Q_w(\psi)$). This is for reflecting the changed ethical rules and the newly added ethical rules. At line−02, actions of a user u_0 are obtained and they are stored to $a(u_0)$, by getAction(u_0), where it is assumed that an action is composed of pairs of behavior and its value. All actions exist in a world

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00: Function: AuditWithWR(P_w(ψ), Q_w(ψ), K)
01:   (P_w(ψ), Q_w(ψ)) ← updateWorldRules(P_w(ψ), Q_w(ψ))
02:   a(u_0) ← getActions(u_0)
03:   z_w ← judgeWRViolation(a(u_0), P_w(ψ), Q_w(ψ), K)
04:   if (z_w) then
05:      enforceWR(u_0, z_w)
06:   end if
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Fig. 3. Audit with world rules

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00: Function: AuditWithRR(P_r(ψ), Q_r(ψ), S, K)
01:   (P_r(ψ), Q_r(ψ)) ← updateRelationalRules(P_r(ψ), Q_r(ψ))
02:   T ← getRelationsInRange(u_0, S)
03:   for i to num(T) do
04:      j ← T[i]
05:      r_j ← getRelationLevel(u_0, S[j])
06:      a(s_j) ← getActions(S[j])
07:      z_{r,j} ← judgeRRViolation(a(s_j), P_r(ψ), Q_r(ψ), K, r_j)
08:      if (z_{r,j}) then
09:         enforceRR(S[j], z_{r,j}, r_j)
10:      end if
11:   end for
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Fig. 4. Audit with relational rules

action set (i.e., a range of possible interactions) for a digital world. At line−03, judge for each action whether violation to the ethical rules is happened or not, by judgeWRViolation($a(u_0)$, $P_w(\psi)$, $Q_w(\psi)$, K) and store the results in z_w. If z_w is not empty, then the procedure to the rule violation is executed to a user with enforceWR(u_0, z_w). For example, the enforcements such as warnings to violated actions, restrictions on service participation are applied to a user.

Let S be a set of subjects, e.g., human avatars, AI avatars, and virtual objects. In Fig. 4, an approach to the auditing with

relational rules, AuditWithRR($P_r(\psi)$, $Q_r(\psi)$, S, K), is shown. The interactions of a subject in S to u_0 are audited. At line−01, $P_r(\psi)$ is updated with the priority $Q_r(\psi)$, by updateRelationalRules($P_r(\psi)$, $Q_r(\psi)$). At line−02, target subjects are classified by getRelationsInRange(u_0, S) and stored to T. For each index, audit with relational rules is performed. At line−04, the index for identification is computed. With the index, a relation between u_0 and $S[j]$ is obtained in the personal influence range. At line−06, actions of a subject $S[j]$ are obtained and they are stored to $a(s_j)$, by getAction($S[j]$). At line−07, the violation is judged with relational rules. At line−09, if $z_{r,j}$ is not empty, then the procedure to the rule violation is executed with enforceWR($S[j]$, $z_{r,j}$, r_j). In this case, depending on relation between a user and a target subject, enforcements are applied to a subject. So, even for the same action, it will be evaluated differently. In a social Metaverse where diversity exists, user−centered rules need to be considered.

B. Examples

When an avatar entered a Metaverse world, it is affected by ethical rules of a digital world. Any actions of a user will be evaluated according to the rules for Metaverse ethics. For example, for the description that 'User A' creates hateful products in 'World X', 'User A' is u_0 and 'creates hateful products' is $a(u_0)$. By AuditWithWR($P_w(\psi)$, $Q_w(\psi)$, K) with rules of the 'World X', evaluation to $a(u_0)$ will be performed.

In the other case, an avatar may request the auditing to a subject, e.g., a human avatar controlled by a user. For example, for the description that 'User A' is being attacked by 'User B', 'User A' is u_0, 'User B' is $S[j]$, the level of a relation between u_0 and $S[j]$ is r_j, and 'is being attacked' is $a(s_j)$. By AuditWithRR($P_r(\psi)$, $Q_r(\psi)$, S, K), evaluation to $a(s_j)$ will be performed.

C. Discussion

Metaverse, which aims for a sustainable digital society, needs to ensure community values such as individual dignity, rights, and equality in each digital world. As soon as a user enters a metaverse world, it needs to be known that certain actions of the avatar can be audited. Ethical activities should be possible without causing inconvenience to users while experiencing service contents.

It is helpful to maintain a sustainable Metaverse through the auditing of avatar interactions under the ethical rules of a Metaverse world and the auditing of interactions causing displeasure to a user. In addition to enacting the Metaverse ethical rules, a separate study is needed to develop applicable ethical rules for various scenarios and to program them in a Metaverse service platform.

In the Personal Information Protection Act, there is a right of self−determination, which is the right of the data subject to decide to whom, when, and to what extent information about himself will be known and used [32]. Ethical rules to ensure the right to self−determination in Metaverse should also be considered.

V. CONCLUSION

This paper sought to review Metaverse ethics and avatar interactions. Following an examination of the auditing approaches to avatar interactions, which were introduced in the two cases that an avatar enters a digital world and that an avatar requests the auditing to subjects. In order for Metaverse to be sustainable, it is necessary to study a method that can be implemented in a Metaverse service platform and automatically audited. Further study to the programable ethics is needed for verification of viability in various scenarios.

REFERENCES

[1]   S. M. Park and Y. G. Kim, "A Metaverse: taxonomy, components, applications, and open challenge," *IEEE Access*, Vol. 10, pp. 4209-4251, Jan. 2022.

[2]   C. B. Fernandez and P. Hui, "Life, the Metaverse and everything: an overview of privacy, ethics, and governance in Metaverse," *arXiv:2204.01480*, Mar. 2022.

[3]   J. S. V. Molano, G. M. Diaz and W. J. Sarmiento, "Parametric facial animation for affective interaction workflow for avatar retargeting," *Electronic Notes in Theoretical Computer Science*, Vol. 343, pp. 73-88, May. 2019.

[4]   J. Bang, "Metaverse R&D Planning and Strategies," *Metaverse Future Forum 22-1st Seminar*, Jun. 2022.

[5]   H. Duan; J. Li; S. Fan; Z. Lin; X. Wu; W. Cai; "Metaverse for social good: a university campus prototype," *Proc. of 29th ACM International Conference on Multimedia (MM '21)*, China, pp. 153-161, Oct. 2021.

[6]   M. Stephens, "Metaverse and its governance," *IEEE Standards Association (SA), The IEEE Global Initiative on Ethics of Extended Reality (XR) Report*, Jun. 2022.

[7]   World Wide Web Consortium - Immersive Captions Community Group. https://www.w3.org/community/immersive-captions/ (accessed July 1, 2022).

[8]   XR Access Initiative - Virtual, Augmented, & Mixed Reality for People with Disabilities. https://xraccess.org/ (accessed Jul. 1, 2022).

[9]   J. P. Williams and D. Kirschner, "Coordinated action in the massively multiplayer online game world of Warcraft," *Symbolic Interaction*, Vol. 35, No. 3, pp. 340-367, Aug. 2012.

[10]   P. Mawhorter, S. Sengün, H. Kwak and Harrell, "Identifying regional trends in avatar customization," *IEEE Transactions on Games*, Vol. 11, No. 4, pp. 405-415, Dec. 2019.

[11]   R. D. Pietro and S. Cresci, "Metaverse: security and privacy issues," *3rd IEEE International Conference on Trust, Privacy and Security in Intelligent Systems and Applications (TPS-ISA)*, Atlanta, GA, USA, pp. 281-288, Dec. 2021.

[12]   E. H. Spence, "Meta ethics for the Metaverse: the ethics of virtual worlds," *Proc. of Conference on Current Issues in Computing and Philosophy*, pp. 3-12, Jun. 2008.

[13]   M. W. Heo, K. C. Park, and G. M. Hong, "User sensitive data classification for IoT gateway security," *Smart Media Journals*, Vol. 8, No. 4, pp. 17-24, Dec. 2019.

[14]   D. Fox, I. G. Thornton, "Extended reality (XR) ethics & diversity, inclusion, accessibility," *IEEE SA Beyond Standards, The IEEE Global Initiative on Ethics of Extended Reality (XR) Report*, Mar. 2022.

[15]   Y. Benkler, "The wealth of networks: how social production

transforms markets and freedom," *Yale University Press*, 2006.

[16]   T. Huynh-The, Q. V. Pham, X. Q. Pham, T.T. Nguyen, Z. Han, and D. S Kim, "Artificial intelligence for the Metaverse: a survey," *arXiv:2202.10336*, Feb. 2022.

[17]   P. Covington, "Success in sociology: AS student book AQA," *Folens Limited*, 2008.

[18]   D. Z. Davis, Chansiri, K., "Digital identities – overcoming visual bias through virtual embodiment," *Information, Communication & Society*, Vol. 22, No. 4, pp. 491-505. Nov. 27, Nov. 2018.

[19]   M. V. Naseh, "Person and personality in cyber space: a legal analysis of virtual identity," *Masaryk University Journal of Law and Technology*, Vol. 10, No. 1, pp. 1-12, Aug. 2016.

[20]   B. C. Cheong, "Avatars in the metaverse: potential legal issues and remedies," *International Cybersecurity Law Review*, Jun. 2022.

[21]   M. D. Griffiths, Z. Hussain, S.M. Grusser, R. Thalemann, H. Cole, M. N. O. Davies, and D. Chappell, "Social interactions in online gaming," *International Journal of Game-Based Learning*, Vol. 1, No. 4, pp. 20-36, Oct.-Dec. 2011.

[22]   M. A. Franks, "Unwilling avatars: idealism and discrimination in cyberspace," *Columbia Journal of Gender and Law*, vol. 20, no. 1, pp. 224-261, Oct. 2009.

[23]   Z. J. Zhong, "The effects of collective MMORPG (Massively Multiplayer Online Role-Playing Games) play on gamers' online and offline social capital," *Computers in Human Behavior*, Vol. 27, No. 6, pp. 2352-2363, Nov. 2011.

[24]   S. Heng, H. Zhao and M. Wang, "In-game social interaction and gaming disorder: a perspective from online social capital," *Front Psychiatry*, vol. 11, Article 468115, Feb. 2021.

[25]   L. K. Kaye and J. Bryce, "Putting the 'fun factor' into gaming: the influence of social contexts on experiences of playing video games," *International Journal of Internet Science*, Vol. 7, No. 1, pp. 23-27, Aug. 2012.

[26]   C. Hillmann, *UX for XR: user experience design and strategies for immersive technologies*, Apress, Singapore, 2021.

[27]   N. Suzor, "The role of the rule of law in virtual communities," *Berkeley Technology Law Journal*, Vol. 25, No. 4, pp. 1817-1886, 2009.

[28]   M. Cortese, and J. Outlaw, "Social and multi-user spaces in VR: trolling, harassment, and online safety," *IEEE SA Beyond Standards, The IEEE Global Initiative on Ethics of Extended Reality (XR) Report*, Dec. 2021.

[29]   I. Ajzen and M. Fishbein, *The influence of attitudes on behavior*, *The Handbook of Attitudes, Lawrence Erlbaum Associates Publishers*, pp. 173-221, 2005.

[30]   J. S. Bang, J. H. You, and Y. H. Lee, "A prototype of flex sensor based data gloves to track the movement of fingers," *Smart Media Journals*, Vol. 8, No. 4, pp. 53-57, 2019.

[31]   W. Kavanagh and A, Miller, "Gameplay analysis of multiplayer games with verified action-costs," *The Computer Games Journal*, Vol. 10, pp. 89-110, 2021.

[32]   J. S. Kim, B. H. Choi, and G. H. Cho, "A study on personal information protection system for big data utilization in industrial sectors," *Smart Media Journals*, Vol. 8, No. 21, pp. 9-18, 2019.

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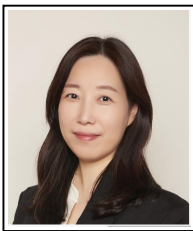
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