Communication Model of Real-time Interactive Avatar: Virtual Public Figure

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Abstract

This paper discusses the widespread use of avatars beyond gaming, which has led to significant changes in the entertainment industry with the emergence of various virtual public figures. Avatars have evolved beyond static forms or limited movements and can now interact with users in a more human-like manner. The author utilizes a self-designed avatar named Crystagella to showcase the potential of avatars as a medium for communication beyond their current applications. To address communication issues between actors, avatars, and audiences, the author employs the design thinking method, resulting in innovation in real-time interaction schematic modeling with avatars. This study provides valuable insights into the potential applications of avatars in various fields, including entertainment, education, and virtual reality. It also highlights the significance of motion capture technology in creating lifelike avatars, with an emphasis on the importance of low latency and detail-oriented motion capture. Overall, this paper contributes to the growing body of research on avatars and their potential in modern communication. The insights gained from this study can serve as a basis for the development of advanced interaction modeling and the design of more intuitive and effective avatar communication tools in the future.

Keywords: communication model, real-time interactive avatar, virtual public figure, Crystagella

I. ENCOUNTER A VIRTUAL PUBLIC FIGURE: AVATAR THAT CAN INTERACTION IN A REAL-TIME

Originally developed from the gaming world, the concept of avatars has evolved beyond the context of games. As we know, avatars can take the form of humans or non-humans, be realistic or stylized, and can be customized with desired attributes and appearances. In the world of gaming, avatars represent players projected into an immersive digital environment, which is a crucial element that enhances interactivity, especially in MMORPG games, where players interact with each other through their avatars. [1]

The concept of avatars has come a long way since its origin in the gaming industry. Avatars have evolved to become a popular means of interaction in various industries, especially in the entertainment industry [2]. With the emergence of virtual bands like Gorillaz and virtual idols like Hatsune Miku, avatars have become an integral part of the music industry [3], [4]. Public figures also use avatars to connect with their audience in a more immersive and interactive way. Avatars have also been used in streaming activities, such as with Kizuna Ai (Figure 1) and Lil Miquela, where communication modeling is critical for successful interaction.
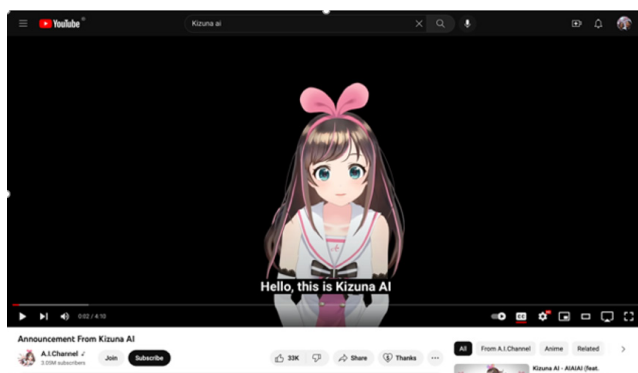
Figure 1 shows a virtual public figure as a new model of avatar, with Kizuna Ai live streaming on YouTube [5].

However, the concept of avatar is not limited to the realm of human-computer interaction. Avatars can be associated with various things such as cosplay or even amusement park clowns. Avatars represent one form of simulation, where something that is thought of virtually by each user can be materialized and simulated in digital form on a computer screen [6]. The term "avatarism" characterizes the recent manifestation of technology applications applied to the creation and usage of personal virtual representations for various purposes. [2]

In his book "Posrealitas, Realitas Kebudayaan dalam Era Posmetafisika," Yasraf Piliang equates television to an interface that creates a virtual world called Fantasmagoria space. This space entices humans to enter a network of speed, madness, hysteria, and lifestyle that it creates [7]. Avatars represent one aspect of this virtual world, allowing users to materialize and simulate their thoughts virtually. This signifies a significant development in various fields, pushing the boundaries of human communication through technology.

A. Avatar as a Communication Medium

Communication is a process of interaction between a communicator and a recipient, aimed at exchanging messages or information. According to Lasswell, communication succeeds if the communicator can effectively transmit the message through the right channel and to the right recipient. This concept emphasizes the communicator's ability to choose the right words, images, and gestures to ensure the message is well-received and understood by the recipient. However,

Schramm argues that communication is more complex as it involves the exchange of messages between two or more individuals or groups using symbols that have the same meaning for all parties involved. Schramm also emphasizes the importance of feedback in communication, so that all parties involved can respond to the received message. [8]

In Schramm's model, communication is illustrated as a circle that involves three essential elements: the communicator, message, and recipient, which are interconnected and interact with each other. Therefore, the success of communication depends not only on the communicator's ability but also on the recipient's ability to understand and provide feedback on the received message. [9]

Schramm proposed a model of the communication process that includes several essential elements to ensure effective communication involves a source creating a message that must have the same meaning for both the communicator and recipient. Encoding and decoding are the processes of converting and breaking down symbols or language, respectively. Channels such as speech, writing, or images are used to convey the message from the communicator to the recipient. The recipient is the individual or group who receives the message and gives feedback to the communicator. Noise can disrupt the communication process. By paying attention to each of these elements, communicators can ensure that their message can be well-received by the recipient. In this state, communication can be seen as transactional model. This model emphasizes the importance of interpersonal aspects in the communication process and that the communication process is not just about sending messages, but also involves active responses from both parties. [9]
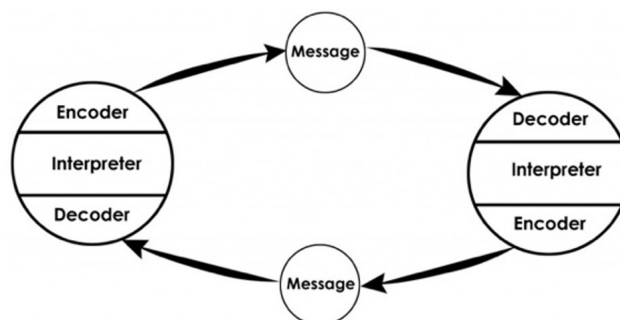

Figure 2 depicts Schramm's communication model. [10]

In the context of real-time avatar interaction, the avatar can serve as a communication medium [1]. According to Yasraf, simulation is a part of language processing [7]. The communicator sends a message through the simulated avatar medium, which represents them to interact with the recipient. The avatar as a communication medium has two components, namely, the character design of the built character and the movement of the communicator resulting from the animation of body movement, expression, and voice. In semantic terms, these two aspects can be defined as a sign. However, the movement of the communicator resulting from the movement of the body, expression, and voice can be defined as the content of the message.

The success of communication that occurs through the avatar medium depends on how both of these components can be elaborated and decoded by the user acting as the recipient. Thus, the avatar can become an effective medium in conveying messages and establishing interactions between the communicator and recipient.

Communication through avatars has the potential to create a feeling of „social presence," which refers to the sense of being together with others in a shared space, despite physical distance. According to Biocca and Harms, social presence refers to „the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship." Avatars can enhance social presence by providing users with visual and auditory cues that help them perceive the presence of others, as well as opportunities for interaction and feedback. [11]

The effectiveness of communication depends on the richness of the medium used. Media richness is defined by the ability of the medium to convey information and enable feedback. Avatars are relatively rich as a medium since they can convey nonverbal cues, such as facial expressions and body language, and enable synchronous interaction. However, their richness may be limited by technological constraints or users' ability to control their avatars effectively. This theory was originally proposed by Daft and Lengel. [12]

Avatars can be used by people to manage their self-presentation in online environments. Users have the option to create avatars that reflect their idealized selves or express their identity in different ways. This theory was first proposed by Goffman [3], and has been applied to online environments by scholars like Yee. [13]

People derive their self-concept from their membership in social groups, and online environments can create new or altered social identities. Avatars can facilitate this process by enabling users to visually represent themselves as members of different groups or communities. Social identity theory was first proposed by Tajfel and Turner [14] and has been applied to online environments by scholars such as Postmes and Spears. [15]

B. The Objective of Study

The purpose of this study is to simulate a real-time avatar interaction process. In this case, the researchers will simulate an actor who will act as a communicator and an avatar named *Crystagella*, which will act as a virtual public figure built by the researchers themselves. Therefore, the objectives of this simulation include two things:

- To gain an understanding of the communication process involved in real-time interactive avatar,
- To construct a schematic of the interaction process that occurs between communicators and recipients in real-time avatar interaction.

By achieving these objectives, this study aims to provide insights into the potential of avatars as a communication medium and contribute to the existing literature on avatar-mediated communication. The insights gained from this study may have practical implications for researchers, developers, and practitioners interested in designing and implementing avatar-mediated communication systems in various domains.

II. Simulating Crystagella to get Her Interaction Model

The avatar that the researchers have built since 2012, named *Crystagella* or Diana Kristarium (Figure 3) [16], will serve as a model for the real-time avatar interaction study. *Crystagella* performed a real-time live interaction in a holographic box at the pop culture exhibition Indonesia Comic Con in 2022 [17]. By using this established avatar, the researchers can focus on analyzing the communication components and building a communi-

cation model in real-time avatar interactions. In addition, the qualitative approach of the Design Thinking method will allow the researchers to gain a deeper understanding of the object.

Design thinking is a problem-solving approach that involves identifying user needs and developing solutions that meet those needs. This methodology is commonly used in the business industry, where companies aim to create innovative products and services that meet the needs of their customers. By using design thinking, businesses can create a user-centered design that is both creative and effective. [18]

One of the key elements of design thinking is user orientation. This means that the development process focuses on the needs and preferences of the end-users. By understanding the user's perspective, developers can design products that are more intuitive and user-friendly. The objective is to create an experience that is engaging and interactive, enabling the user to achieve their goals in a seamless manner. [18]

the avatar to change their appearance, while the recipients use it to interact directly. Design thinking can be used to define the problems that occur when an actor simulates an avatar in order to develop an effective communication process.

By using design thinking in their study, the researchers can define real-time avatar interaction in a more comprehensive manner. This methodology allows for a more in-depth analysis of the user's needs and preferences [18], enabling the researchers to create a schematic that is both innovative and effective. The resulting innovation can then be used to develop new and improved products and services that meet the needs of the end-users. Overall, design thinking is a valuable tool that can be used to create innovative solutions that meet the needs of users in a variety of contexts.
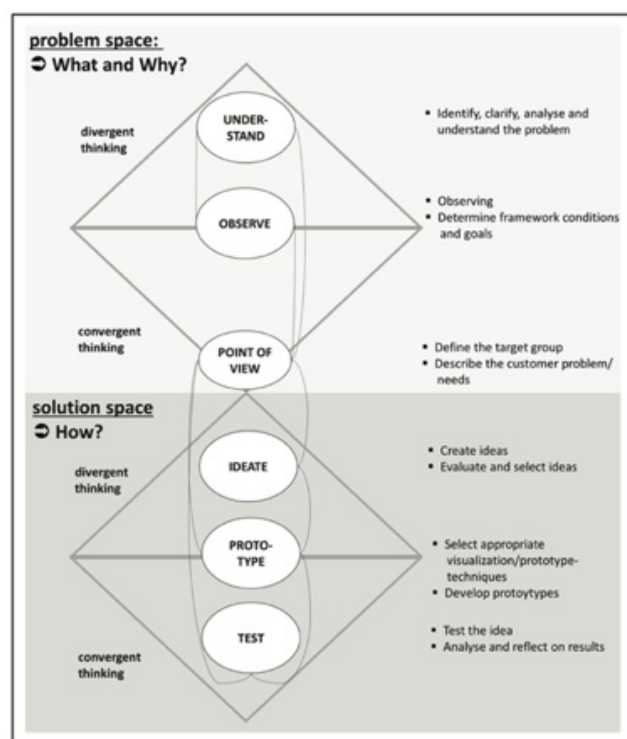

Figure 3. Using Crystagella as a model to study real-time avatar interaction.

Figure 4. Design thinking process [18]

In the context of real-time avatar interaction, design thinking plays a crucial role in ensuring that the interaction between the communicators and recipients is effective. The communicators and recipients play different roles, and the avatar serves as the medium of communication between the two parties. The communicators use

In the context of communication, the message sender is commonly referred to as the communicator. However, I prefer to refer to them as "*The Actor*," and the recipient as "The Viewer" To gain a better understanding of the real-time avatar interaction process using the Design Thinking method, the process can be divided into six distinct phases, as shown in Figure 4:

Understanding the problem

The initial stage focuses on gaining comprehension of the challenge, problem, need, or requirement (problem understanding). The communication process is divided into three parts: *The Actor* simulating *Crystagella*, *Crystagella* interacting with *The Viewers*, and *The Viewers* providing feedback to *The Actor*.

Observation

This is conducted to gather data related to the needs or problems in a communication process. The observation process involves recording when *The Actor* is simulating *Crystagella*, with a focus on the hardware needed to build interpersonal communication. Meanwhile, interactions between *Crystagella* and *The Viewers* are captured by taking screenshots. Interviews are also conducted with *The Actor* simulating *Crystagella* to analyze the necessary hardware when receiving feedback from *The Viewers*.

Define the Problem

Following the process of observation, the collected data should be synthesized to identify a typical user whose communication problem or need can be summarized in a clear and well-defined question. This approach of condensing the data is essential to develop a deep understanding of the user's perspective and to formulate an effective solution to their problem. By focusing on a single prototypical user, the design team can ensure that the solution is tailored to address the specific needs and preferences of the user, rather than being a generic solution that does not fully address the underlying problem.

Ideate

During this phase, the actual brainstorming process occurs, where ideas for the communication hardware are generated. It is important to keep this process separate from the previous phase. Once the ideas have been generated, they are analyzed in terms of *The Actor*, The Avatar (*Crystagella*), and *The Viewers* to identify any weaknesses. Finally, the ideas are evaluated, and a selection decision is made based on their strengths and weaknesses. This is a crucial phase in the design thinking process, as it involves generating and evaluating ideas to address the user's needs identified in the previous phase.

Prototyping the simulation

During this crucial phase, the ideas generated in the previous phase will be rapidly visualized, tangible prototypes will be created, sketches will be designed, and models/simulations will be developed. This is done to prepare the necessary hardware for the communication process and to constantly iterate the process until a satisfactory outcome is achieved. The visualization and prototyping allow for a better understanding of how the communication hardware will work and enable the team to identify any potential issues early on. If new needs or problems are identified, the process will cycle back to the define phase to address them (Figure 4).

In the context of prototyping for *Crystagella*, the prototyping process takes place in a studio. Ideas from previous phases are refined and supplemented with the purchase, creation, and modification of hardware components. This is done in the form of online streaming through various platforms, such as Twitch and Instagram Live.

The content of the live streams is varied and tailored to *Crystagella*'s brand positioning. This includes interviews about the release of singles and albums, talk shows about music and fashion, and other relevant topics. The goal of the live streams is to provide an interactive and immersive experience for users to engage with *Crystagella* and create a community around the avatar.

The use of Design Thinking in the prototyping process allows for a user-centered approach, which ensures that the needs and desires of the users are prioritized. By prototyping in a studio, the team can iterate and refine the hardware and software components of *Crystagella* to ensure a seamless and engaging experience for users.

Overall, the use of online streaming platforms and diverse content for *Crystagella* demonstrates the versatility and potential of avatars in entertainment and communication. The ongoing prototyping process ensures that the avatar remains relevant and engaging for users, reflecting the evolving landscape of technology and user preferences.

Testing

In the final phase, the ideas that have been generated need to be refined and tested through further experiments and user feedback. This process may circle back to the Define phase or move

on to the Prototyping phase if it is related to improving a particular hardware component (Figure 4). Once satisfaction is achieved with all components of communication, the end result will be a schematic interaction for real-time interactive avatars. This process of refinement and testing will continue until the desired level of functionality and usability is achieved.

To further test the real-time interaction process of *Crystagella*, a testing phase was conducted at the Indonesia Comic Con 2022 event on October 1-2, 2022. The interaction was carried out using a holographic box that allowed *Crystagella* to interact directly with *The Viewers* (Figure 5). The testing phase consisted of two main content segments: live chatting sessions and a DJ show performed on stage.

Figure 5. Crystagella live in holographic box.

Figure 6. Crystagella interaction booth at Indonesia Comic Con 2022.

The live chatting sessions were held for two days at an exclusive booth for *Crystagella* at Indonesia Comic Con, during which *The Viewers* were able to engage in direct conversation with *Crystagella* (Figure 6). Through these interactions, we were able to observe and gather data on how

The Viewers interacted with the avatar, allowing us to gain insights for future improvements. By circling back to the prototype and define phases with the data gathered from this testing phase, we will be able to make more comprehensive improvements to the interaction process of *Crystagella*.

III. Discusion

A. The Actor and Crystagella as an Interpersonal Communication

When *The Actor* simulates an avatar, it's like a concept of reflection or in the communication theory can be define as an interpersonal development. In this case, the movement of *The Actor* constructed the animation and the voice character design of *Crystagella*.

The Actor uses motion capture technology that includes body movement and facial expressions, which are then applied to a *Crystagella*. *The Actor* can see on the computer screen how the character is animated to match the movements simulated by themselves. When *The Actor* raising the hand, *Crystagella* will raising the hand, when *The Actor* shaking the head, *Crystagella* will shake her head. The same thing with regards to sound, the mouth movements must match the sound produced by *The Actor*.

Therefore, before the real-time avatar interaction is witnessed by *The Viewers*, who is the recipient, it is necessary to have a monitor uses to *The Actor* encoding The Avatar that includes both audio and visual elements. To understand the process of forming the interpersonal model between *The Actor* and The Avatar, it can be seen from the diagram on figure 7.

Looking at the diagram on figure 7, the things that need to be considered in forming an avatar's interpersonal include:

- Fullbody movement; *The Actor* utilizes motion capture technology that is connected to the avatar (Figure 7).
- Facial movement; It produces two outputs, facial capture, which utilizes motion capture technology, and voice capture, which is recorded using a microphone.
- Monitor or Virtual Mirror; Both components are displayed on a monitor in the form of audio and video for monitoring and evaluating the Avatar by *The Actor*.
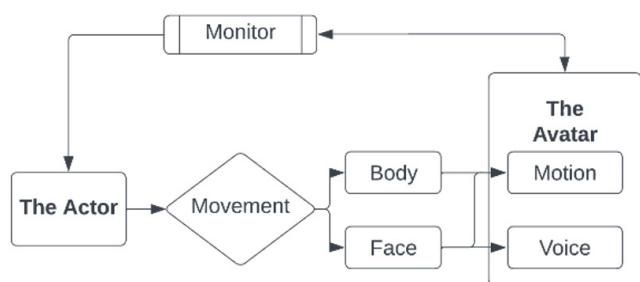
Figure 7. illustrates the encoding process used to simulate The Avatar.

The success of the encoding process in forming the interpersonal relies on the quality of the three aforementioned medium aspects. For the animation, the following aspects should be taken into consideration:

- The lower the latency of the motion capture, the more closely the avatar's movements will match those of *The Actor*.
- The level of detail in motion capture depends on the number of markers that can be placed on each joint of the body. The more markers used in the motion capture process, the more detailed the resulting movements will be, such as the use of markers on each fingertip joint.

Figure 8. showcases the facial motion capture system, complete with the helmet. [19]

To generate facial movement, two outputs are produced. The first is related to facial capture to create facial movements, while the second is voice development, where the quality of the microphone should be carefully considered. There-

fore, to synchronize these two aspects in building facial movement, the following aspects should be considered:

- Types of microphones divided into 3 types, namely condenser, dynamic, and ribbon. These three types are differentiated by their frequency response and polar pattern aspects. The microphone type selection should be adjusted to the needs.
- Proper microphone placement is sticking to the head. However, the microphone placement should be considered to not disturb the facial capture process.
- Similar to the previous point, must be installed to follow the head's movement. One way is to use a device called a facial capture helmet. In addition, the size and weight are the main concerns, the smaller and lighter the device, the more *The Actor* can move their head freely.
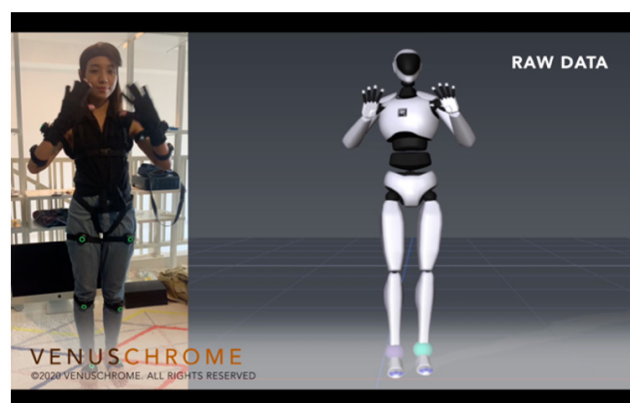

Figure 9. depicts the motion capture of real-time avatar movement.

The Monitor component is what makes the simulation of the Avatar by *The Actor* a form of interpersonal communication. There are also aspects that need to be considered in monitoring, as follows:

- Separate audio and visual monitors are better, where the voice can use earphones while the animation can be viewed on a television screen.
- The placement of the monitors is important, which is parallel to the direction of motion capture so that the Avatar will appear to be speaking with its conversational partner. However, the placement must not interfere with the facial and motion capture processes.

B. They Are Not Talking with You (The Actor), They Are Talking with the Other You, it's Crystagella!

In the context of the sub-topic above, it is true that " They Are Not Talking with You (*The Actor*), They Are Talking with the Other You, it's *Crystagella*!". Despite the fact that the sender of the message remains *The Actor*, *The Viewers* interprets it as the movements, expressions, and voice of the avatar. This refers to the sub-topic *The Actor* and the Avatar as an Interpersonal Communication. The simulation of *The Actor* into an avatar creates a new interpersonal communication.

Figure 10. illustrates Crystagella's real-time interaction with people (@bolehmusic) on Instagram Live.

In this context, *The Actor* is no longer known as themselves. *The Viewers* sees them as *Crystagella* (Figure 10). Referring to the components of a message in communication theory, there are two, which are language and sign [8]. What *The Actor* does is positioned as a language, while the movements, expressions, and voice of *Crystagella* (avatar) are a sign. For a clearer understanding, Table 1 provides an example.

Table 1. provides an example of what The Actor encoded and what The Viewers decoded of Crystagella.

Character Design (Sign)	Language	
	The Actor do (encoded)	*The Viewers* see (decoded)
The Animation	Movement of *The Actor*	Movement of *Crystagella*
	The Actor waving hand	*Crystagella* waving hand
	The Actor jumping	*Crystagella* jumping
	The Actor kicking	*Crystagella* kicking
	The Actor shaking head	*Crystagella* shaking head
The Expression	*The Actor* smiling	*Crystagella* smiling
	The Actor sad	*Crystagella* sad
The Voice	Voice of *The Actor*	Voice of *Crystagella*
	The Actor singing	*Crystagella* singing
	The Actor talking	*Crystagella* talking

C. Crystagella Cannot See and Hear The Viewers, The Actor Can!

Animated *Crystagella* looks real, but it is still just an avatar. As previously mentioned in the sub-section "*The Actor* and *Crystagella* as an Interpersonal Communication", the simulation of *The Actor* into *Crystagella* creates a new form of intrapersonal communication. From a communication perspective, *Crystagella* remains a medium of communication, with *The Actor* as the source of the message and communicator.

According to Schramm, communication is a transactional process that involves feedback [8], [9]. After the communicator delivers a message to the recipient, the recipient sends feedback to the communicator [8]. However, in the context of

feedback in avatar interactions, the process does not revolve around the avatar but uses another medium directrly interact with *The Actor* (Figure 11).
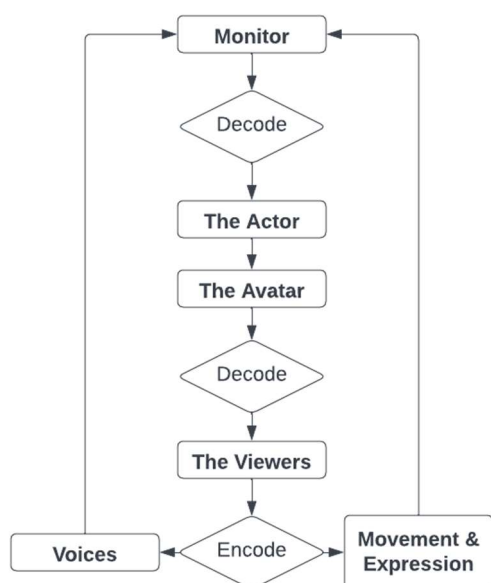

Figure 11. shows the feedback process from The Viewers through The Actor.

In this context of modeling, the form of interaction is almost similar to what has been discussed in the subchapter "*The Actor* and *Crystagella* as an Interpersonal Communication". This indicates the importance of proper monitoring to achieve effective communication. As previously men-tioned, the components of the monitor should be split between audio and visual to allow for great-er focus on each aspect of communication. This can be achieved by using earphones for the voice component and a television for the visual com-ponent.

Additionally, the placement of the monitor should be carefully considered to ensure that it is aligned with the motion capture direction. This will help create the illusion that the avatar is talking to its counterpart. However, the place-ment should not interfere with the facial and mo-tion capture processes. By properly implement-ing these aspects, the communication between *The Actor* and *The Viewers* can be enhanced, re-sulting in a more realistic and effective interac-tion.

D. So How They Communicate Each Other Through the Avatar?

Continuing from the previous subchapter, the process of building the real-time interactive ava-tar is divided into three main discussions: the for-mation of intrapersonal communication between *The Actor* simulating The Avatar, the encoding and decoding process of a message where The Avatar communicates with *The Viewers*, and fi-nally the feedback process captured by *The Actor* and sent by *The Viewers*. The complete modeling of the real-time interactive avatar interaction can be seen in figure 12.

Real-time Interactive Avatar Communication Model
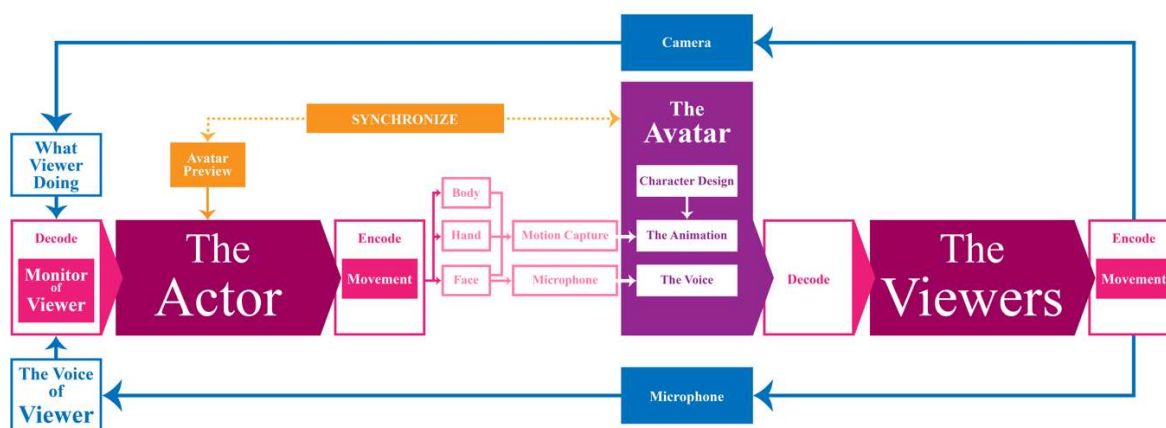
Figure 12. illustrates the interaction model of a real-time interactive avatar, which demonstrates the dynamics of user-avatar engagement in real-time settings.

This model represents the complex process of communication between *The Actor*, The Avatar, and *The Viewers*, which involves not only language but also nonverbal cues such as gestures, facial expressions, and tone of voice. It is important to note that in this model, *The Actor* and The Avatar are not considered as separate entities but rather as a single unit forming a new interpersonal communication. The encoding and decoding process is also crucial in ensuring effective communication, as The Avatar's movements, expressions, and voice must be properly interpreted by *The Viewers*. Finally, the feedback process plays an important role in improving the communication process by allowing *The Actor* to adjust their communication based on the responses of *The Viewers*.

IV. Conclusion

In addition, the use of real-time interactive avatar in interpersonal communication has significant implications in terms of bridging the gap between physical and virtual communication. This type of avatar allows individuals to communicate and interact in a virtual environment in a more natural and human-like way, creating a more immersive experience for both *The Actor* and *The Viewers*.

Moreover, the development of such an avatar requires a thorough understanding of the communication process and the technical knowledge to implement it. The process involves several phases, including defining the problem or need, observing the communication process, brainstorming and visualization, prototyping, and testing. These phases require a multidisciplinary approach and collaboration between experts in fields such as psychology, communication, design, and technology.

One of the main advantages of real-time interactive avatar is its potential application in various fields, including education, entertainment, and healthcare. For example, in education, it can be used to create immersive and interactive learning experiences, where students can interact with avatars to learn and practice new skills. In healthcare, it can be used for telemedicine and remote patient monitoring, allowing healthcare professionals to interact with patients virtually and monitor their health remotely.

the concept of real-time interactive avatar, which Schramm created, provides a new and innovative approach to interpersonal communication [9], that has significant potential for various applications, such as education, entertainment, and healthcare. In education, avatars can provide an immersive and interactive learning experience that can improve student engagement and understanding of complex concepts. In entertainment, avatars can enhance the user experience by providing a more personalized and interactive entertainment experience. In healthcare, avatars can be used to facilitate remote consultations and telemedicine, allowing patients to receive medical care without leaving their homes.

Moreover, the concept of real-time interactive avatar also has the potential to transform the way we communicate and collaborate in virtual and remote settings. Avatars can provide a more natural and intuitive way of communicating and collaborating, allowing for a more seamless exchange of ideas and information. In virtual meetings and remote work, avatars can help bridge the gap between physical distance and improve team collaboration and productivity.

However, the development of real-time interactive avatar also presents various challenges and ethical concerns. For instance, the use of avatars for communication and collaboration raises questions about privacy, security, and identity. It is crucial to ensure that users' personal information and data are protected and that avatars are not used to misrepresent or manipulate others.

In conclusion, real-time interactive avatar has significant potential for various applications and can transform the way we communicate and collaborate in virtual and remote settings. However, its development also requires careful consideration of ethical concerns and challenges that may arise.

For future research, there are several areas that can be developed from the interaction model mentioned above. One of them is related to the development of server systems for direct avatar interactions. Various modeling can also be developed through the basic scheme, such as live control systems, or even to an Actor who can live together in several places. Additionally, further research can be conducted to investigate the effectiveness of avatars as an immersive media.

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