CoRe Essay 5
Verbal and Nonverbel:
Communication of Embodied Chat Robot

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Abstract

The field of embodied chat robots has opened new horizons in human-computer interaction, introducing the potential for more natural, engaging, and emotionally resonant conversations. Nonverbal expressions, encompassing facial expressions, body language, and simulated eye contact, play a pivotal role in conveying emotions, intentions, and engagement. Through careful design and thoughtful implementation, embodied chat robots can establish a profound sense of relatability, trust, and empathy with users. The strategic combination of verbal and nonverbal cues, examined in this essay, allows robots to respond contextually, indicating active listening, emotional reactions, and support. The integration of nonverbal expressions can also facilitate smoother transitions between topics and signal empathy during challenging conversations. This essay explores the design and integration of nonverbal expressions in these robots, with a focus on enhancing the user experience.

1 Introduction

In the realm of human-computer interaction, the development of embodied chat robots has introduced a novel dimension to communication. These robots, designed to engage users in natural and meaningful conversations, leverage both verbal and nonverbal expressions to create a more authentic and relatable interaction. As technology continues to evolve, the ability of these robots to convey emotions, intentions, and engagement through nonverbal cues becomes increasingly significant.

The ideal embodied chat bots should have no difficulties in communicating with humans in the way we are accustomed to, both verbal and nonverval. The impressive performance of advance large language models(LLMs) like ChatGPT shows that verbal communication of a chat bot and a human has reached a milestone. However, according to research from Albert Mehrabian[8], over a half of face-to-face communication is nonverbal in our daily lives(The 55/38/7 Formula), while chat bots equipped with nonverbal expression skills is not satisfying enough as of today. Thus, nonverbal expression design and its combination of verbal expression are necessary.

This essay aims to unravel the complexities of this evolving field, shedding light on the design principles that guide the creation of these nonverbal expressions and the strategic choices that dictate when and how they are employed. By doing so, we hope to provide valuable insights into the evolving landscape of embodied chat robots and the potential they hold for redefining the way humans interact with artificial entities.

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2 Nonverbal Expression Design

The design of nonverbal expression of an embodied chat bot is of great complexity, involving considerably complicated robotics implementation on the ground. In this section, only the form of nonverbal expressions and relevant simple ideas will be covered.

Here, I will briefly introduce three types of nonverbal expression, facial expressions, body language and eye contact, although there are different categories in related works before.[4]

2.1 Facial Expressions

Facial expression is a necessary part of nonverbal expression. The expressions observed on the faces of others trigger a complex interplay of cognitive processes. Emotional expressions can swiftly provoke responses that mirror the conveyed emotion, and these responses can occur even when the observed faces are presented subconsciously. Moreover, humans excel at consciously recognizing and articulating the specific emotions conveyed by these expressions.[3]

Designing the facial expressions of an embodied chat bot is a multifaceted process that involves both the physical design (for physical robots) and the digital representation (for virtual avatars). The former is complex, while the latter is much easier. In fact, digital representation of facial expressions could be as simple as emojis on a screen.

Figure 1: An LLM driven embodied chat bot, FurChat system, with facial expression design[6]

2.2 Body Language

Incorporating physical movements into a robot's body language can greatly enhance its ability to communicate and interact with humans in a more natural and engaging manner. For example, if the robot has a physical body, it will be more human like if incorporated movements such as leaning in to show interest, leaning back to convey relaxation, or shifting weight to indicate attention are implemented. Especially, as a very dexterous part of our body, our hands are able to convey information efficiently via gestures. We take gesture as a part of body language here, although some people often discuss gesture alone.

The key to effectively incorporating these movements is to ensure that they are natural and contextually appropriate. The robot should analyze the conversation in real-time to determine when

and how to use these movements. Additionally, the speed and degree of the movement should be calibrated to match the level of interest or relaxation being conveyed.

However, considering that body language may not always represent the same meaning in multicultural scenarios, what kind of body language we choose to add should be cautiously investigated, apart from the examples I have mentioned above.[2]

Figure 2: Embodied robot T-1000 in science fiction movie, which can use gesture[1]

2.3 Eye Contact

Eye contact is a fundamental element of nonverbal communication that carries significant importance in various aspects of human interaction.[5]

In animals, there is almost no structure similar to the white part of the human eye that has evolved. The combination of the white part and the eyeball enables the human gaze and eye contact to become a viable mode of communication. This well-known hypothesis is called Cooperative eye hypothesis.[7]

Perhaps eye contact is an unique type of communication that only we humans possessed. On the other hand, we actually use eye contact frequently. When speaking to another person face to face, we usually watch each other's eyes. This habit makes eye contact a natural part of communication. Also, humans can take hints from eye contact easily even without words, just like other forms of nonverbal expression.

3 Combination of Verbal and Nonverbal Communication

The embodied chat bot we design should have the ability to communicate its counterparts like human and other robots both in verbal and nonverbal way. However, when and how it combine verbal and nonverbal expressions may not be completely the same as humans.

In my understanding, we humans actually do not use nonverbal expression on purpose when speaking, if our verbal and nonverbal expressions do not have different meanings, especially in complex social scenarios. Our nonverbal expression may be emotion-driven, not purpose-driven under this kind of assumption. For example, when we are arguing drastically, our faces may blush and our voice may turn higher involuntarily. We do not want to show something like anger intentionally.

Whether the embodied chat bot has self-conscience or emotion is another deep and controversial issue, which will not be discussed in this essay. As a result, only executing nonverbal expression when necessary is a rational choice. There are several dimensions we can take into consideration.

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Suppose this embodied chat bot is able to model the world around it, including the environment and the agents' mind, it should combine nonverbal expression with verbal expressions when the agent it wants to communicate can see it, or it is in a complex social situation that it can not convey the real meaning via verbal expression.

How to combine verbal and nonverbal expressions depends on the physical structure of this embodied chat bot. For example, if it is equipped with a screen and speaker, it can adopt facial expression and eye contact using pattern on its screen while conveying verbal message via speaker. If it has a human-like body, it can adopt the same way we humans use nonverbal communication.

4 Challenges

In fact, the embodied chat bot discussed in this essay is hard to implement in current stage. In this section, several challenges will be briefly introduced.

First of all, the sophisticated nonverbal expression involves many sophisticated motions, which are hard to carry out since it requires much more advanced robotics algorithms than what we have today.

Apart from that, sensor and actuator are limiting performance as well. Physical chat bots often have limited sensors and actuators for nonverbal expressions. They may lack sophisticated cameras, microphones, or mechanisms for gestures and facial expressions, limiting their ability to capture and convey nonverbal cues effectively.

What's more, the nature of nonverbal expression may be a double-edged sword. Nonverbal expressions are easier to be misinterpreted than nature language. Also, a small different may result in huge change in meaning. So assuring information to be accurate is a challenge.

5 Conclusion

Verbal and nonverbal expressions are both important part of communication. To enhance user experience, making the embodied chat bot able to use nonverbal expression is vital.

It's important to strike a balance between verbal and nonverbal expressions to ensure that the robot's behavior is appropriate for the context and user preferences. The key is to make the interactions feel natural and empathetic, enhancing the overall user experience and facilitating more effective communication.

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