

# A feasibility study of generative AI applications using EV-3 Robots at the Kyushu Institute of Information Sciences

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## Abstract

The advent of generative artificial intelligence (Gen AI) using large language models (LLMs) has brought about a transformation in the fields of education and home robotics. This study examines how students at the Kyushu Institute of Information Sciences perceive and utilize ChatGPT, with a particular on their familiarity, ethical considerations, and trust (FET) concerns. To further investigate this, we developed an educational EV-3 robot powered by ChatGPT and simulate the voice command using socket connections. By combining surveys with hands-on experiments, we uncovered the strengths and limitations of both the educational and home robotics roles. Our findings highlight the importance of FET, and 88% of respondents have no issues with implementing such technologies in the future.

*Keywords:* EV3-Robot, FET, Gen AI, LLM, socket connections.

## 1. Introduction

A trend application of Generative Artificial Intelligence (GenAI) is Chat Generative Pre-Trained Transformer (GPT) [1], which adapts the LLMs from the GPT series, not only demonstrating an ability to communicate with humans, but also having an impact in academia. A study by Wayne Xin Zhao, et. al. shows a sharp increase after the release of ChatGPT: the average number of published arXiv papers containing "large language model" in the title or abstract rises from 0.40 per day to 8.58 per day [2].

In robotics, a study by Sai H. Vemprala, et al. shows that ChatGPT can be effective in solving several such tasks, while allowing users to interact with it primarily via voice commands [3]. This may indicate that certain tasks, such as home robotics, would rely heavily on such technologies, as they provide the closest natural interaction.

However, there are challenges to using ChatGPT for educational [4] and home robotics applications. We take a small step to observe in terms of familiarity, ethics and trust (FET). From an 'F', familiarity perspective, users may not have adequate understanding, leading to misuse or over-reliance on its suggestions [5]. From an 'E', ethical perspective, the potential for biased responses or unintended behavior poses risks [6], particularly when interacting with children or elderly users. Finally, trust concerns arise from the lack of transparency in

ChatGPT's decision-making process, which may lead to reluctance or overconfidence in its results despite limitations [7]. Addressing these issues will require robot simulation and survey input.

Developing synchronization communication link between two node or module is necessary [8], [9]. In our previous study, we presented the Education EV3-Robot [10] for simulating a "person" detection by using the client-server communication model [11]. In this study, we present the use of application ChatGPT as a EV3-Role and designing where the local-PC can directly access so that the EV3-Robot can be driven by voice command. We extend by conducting a survey to assess the potential applications of these technologies in the areas of education and robotics research in the students of Kyushu Institute of Information Sciences (KIIS). We evaluate the strengths and limitations of both the educational and home robotics roles of the perception and use of ChatGPT, with a particular focus on familiarity, ethical considerations, and trust (FET) concerns.

## 2. Methodology

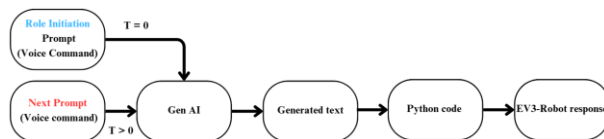


Fig. 1. Voice Command-Driven EV3-Robot Using Generative AI.

### 2.1. ChatGPTs as EV3-Robot role

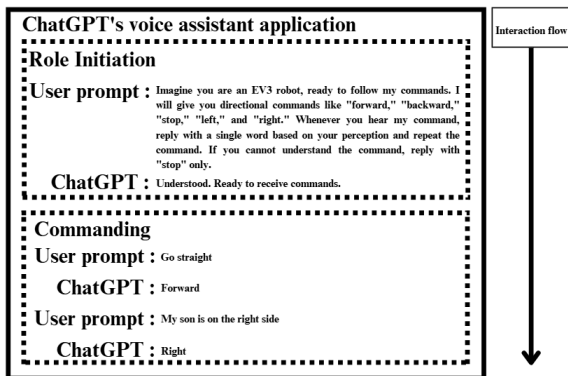


Fig. 2. Interaction ChatGPT as an EV3-Robot role.

In Fig. 1 shows how the voice commands utilized to interact with an EV3-Robot through a Gen AI model of ChatGPT voice assistance application [12]. The interaction commences with Role Initiation ( $T = 0$ ), wherein the user provides an initial prompt via a voice command, thereby defining the role and task to be performed. Subsequent to the initiation of the role, the process transitions to Commanding ( $T > 0$ ), wherein the user continues to issue voice commands to direct the tasks, as illustrated in Fig. 2. These commands are processed by ChatGPT, which interprets the user's input and generates an appropriate response. The generated text by ChatGPT serves as the foundation for creating specific instructions or code. This text is then translated into Python Code that is executable and tailored for the task. Finally, the Python Code is executed on the EV3 robot, resulting in the desired robotic action based on the original commands.

### 2.2. System architecture

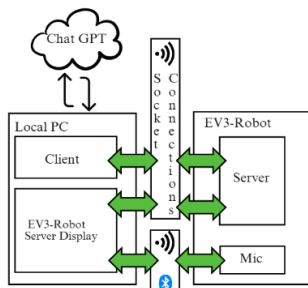


Fig. 3. System architecture.

Fig. 3 shows a system architecture for communication between a local-PC running a client and an EV3-Robot functioning as a server, with support from ChatGPT for generating responses. The system employs socket connections for communication between components. The local-PC facilitates the transmission and reception of data to and from the EV3-Robot via socket connections. The EV3-Robot, operating as a server, processes incoming data and may provide outputs, such as movement instructions or responses through its microphone wirelessly using Bluetooth.

### 2.3. Socket Connection for Voice-Controlled EV3-Robot

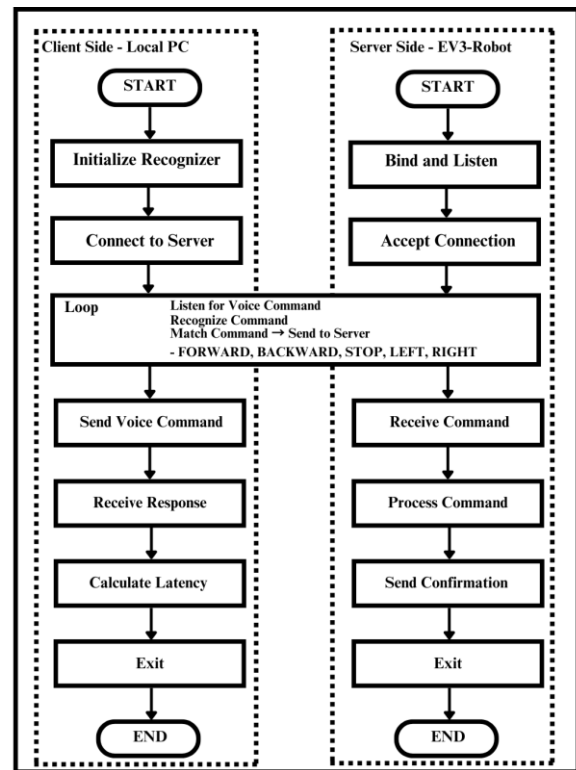


Fig. 4. Client-Server Socket Connection for Voice-Controlled EV3-Robot

In Fig. 4 shows a flow of a socket-connection communication system between a local PC (client) and an EV3-Robot (server) [13]. The system enables the control of the robot using voice commands through a client-server model.

The client system begins by initializing the recognizer, which captures and interprets voice commands, before establishing a socket connection with the server running on the EV3-Robot. It then continuously listens for voice inputs, recognizes commands such as "FORWARD," "BACKWARD," "STOP," "LEFT," or "RIGHT," and matches the recognized input. Once a command is identified, it is sent to the server via the socket connection, and the client waits for a response or confirmation that the command has been processed. The system also calculates the latency between sending the command and receiving the server's response to monitor performance. Finally, the client terminates the process after completing the necessary actions.

The server on the EV3-Robot begins by initializing, binding to a specified port, and listening for incoming client connections. Upon receiving a connection request, the server accepts it to establish communication with the client. It then processes the commands sent by the client, executing the corresponding actions on the EV3-Robot, such as moving forward or turning left. After successfully executing a command, the server sends a confirmation back to the client. Once all tasks are completed, the server terminates its process.

### 2.4. FET survey queries at KIIS students

As part of our demonstration of proposal technology to KIIS students, we aim to gather feedback on their experiences and attitudes towards ChatGPT, an advanced AI language model. The evaluation focuses on three key dimensions: Familiarity, Ethics, and Trust (FET), with a 5 questions per category with score of agreement between 1 (disagree) to 5 (fully agree), and 1 additional “yes or no” question for overall evaluation.

For the Familiarity: 1.) Do you feel fully-utilizing ChatGPT according to your needs?; 2.) Do you feel the interaction with ChatGPT naturally?; 3.) Are you aware with the information provided by ChatGPT?; 4.) You didn’t encountered any instances where ChatGPT’s responses were unclear or difficult to understand?; 5.) Do you think ChatGPT understood your inputs and intentions?

For the Ethics: 1.) Do you agree ChatGPT’s responses avoid including personal information such as race, gender, religion, sexual orientation, or physical/mental disabilities?; 2.) Do you find the responses provided by ChatGPT to be appropriate?; 3.) Did you experience the presence of bias, such as racism, sexism, or other forms of abusive behavior, in ChatGPT's interactions?; 4.) If you find ChatGPT’s responses unpleasant, would you prefer having alternative options (e.g., rephrased answers, additional information)?; 5.) No ethical concerns that arose during your interaction with ChatGPT?

For the Trust part: 1.) Do you trust the accuracy of the information provided by ChatGPT?; 2.) Do you find ChatGPT’s responses to be consistent across interactions?; 3.) Does the information provided by ChatGPT align with your expectations and needs?; 4.) Do you think the sources and references of information provided by ChatGPT are clearly indicated and verifiable?; 5.) Do the information provided by ChatGPT matches what you were looking for?

We have 42 students as a respondent to score each question and provide qualitative feedback to help us better understand the feasibility of ChatGPT technology to be adopted in EV3-Robot based on their experiences.

## 3. Results and Discussion

### 3.1 Familiarity

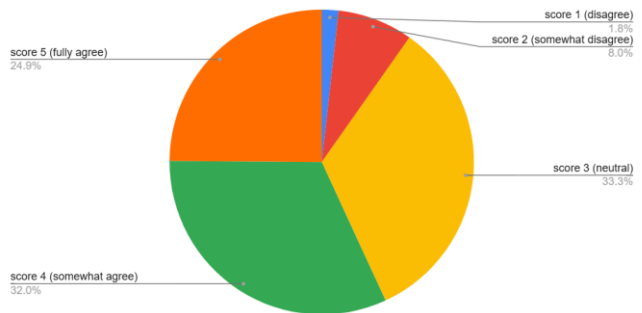


Fig. 5. Familiarity score results.

Fig. 5 shows the familiarity score results, which were calculated as the average of the total scores for each question. The majority of respondents gave a score of 3 (neutral), closely followed by a score of 4 (somewhat agree), with the two being highly competitive.

### 3.2 Ethics

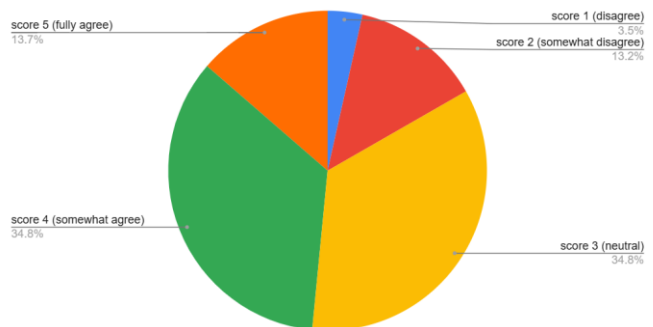


Fig. 6. Ethic score results.

Fig. 6 shows the Ethics score results, which were calculated as the average of the total scores for each question. The majority of respondents gave a score of 3 (neutral) and 4 (somewhat agree) equally.

### 3.3 Trust

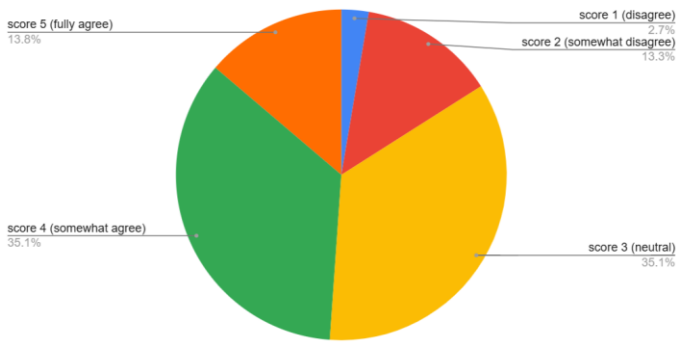


Fig. 7. Trust score results.

Fig. 7 shows the Ethics score results, which were calculated as the average of the total scores for each question. The majority of respondents gave a score of 3 (neutral) and 4 (somewhat agree) equally.

### 3.4 Overall Evaluation

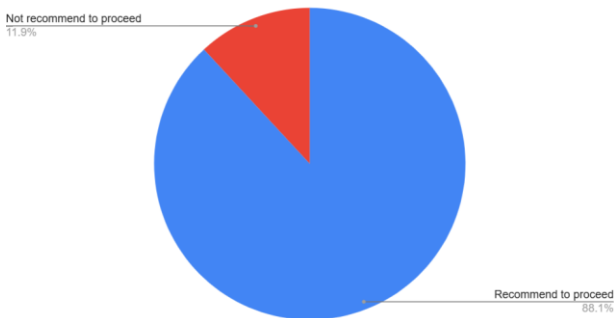


Fig. 8. Overall results.

Fig. 8 shows that nearly 88.1% of the 42 respondents recommend proceeding with the technology utilizing ChatGPT.

## 4. Conclusion

We successfully implemented ChatGPT in the role of an EV3 robot and developed a voice-controlled socket connection for the EV3 robot. Additionally, we studied the feasibility of generative AI applications, such as ChatGPT, in EV3 robots at the Kyushu Institute of Information Sciences. From the FET perspective, respondents tended to be "neutral" or "somewhat agree," with nearly 90% of the 42 participants recommending proceeding with the utilization of ChatGPT technology for the EV3 robot.

## Acknowledgements

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## References

- G. Yenduri et al., "GPT (Generative Pre-Trained Transformer)— A Comprehensive Review on Enabling Technologies, Potential Applications, Emerging Challenges, and Future Directions," in *IEEE Access*, vol. 12, pp. 54608-54649, 2024.
- Zhao, Wayne Xin, Kun Zhou, Junyi Li, Tianyi Tang, Xiaolei Wang, Yupeng Hou, Yingqian Min et al. "A survey of large language models." *arXiv preprint arXiv:2303.18223* (2023).
- Padmanabha, Akhil, et al. "Voicepilot: Harnessing LLMs as speech interfaces for physically assistive robots." *Proceedings of the 37th Annual ACM Symposium on User Interface Software and Technology*. 2024.
- Yu, Hao. "Reflection on whether Chat GPT should be banned by academia from the perspective of education and teaching." *Frontiers in Psychology* 14 (2023): 1181712.
- Roganović, Jelena. "Familiarity with ChatGPT Features Modifies Expectations and Learning Outcomes of Dental Students." *International Dental Journal* (2024).
- Stahl, Bernd Carsten, and Damian Eke. "The ethics of ChatGPT—Exploring the ethical issues of an emerging technology." *International Journal of Information Management* 74 (2024): 102700.
- Choudhury, Avishek, and Hamid Shamszare. "Investigating the impact of user trust on the adoption and use of ChatGPT: survey analysis." *Journal of Medical Internet Research* 25 (2023): e47184.
- Pramanta, D., Morie, T. and Tamukoh, H., 2017. Synchronization of Pulse-Coupled Phase Oscillators over Multi-FPGA Communication Links. *J. Robotics Netw. Artif. Life*, 4(1), pp.91-96.
- Pramanta, D. and Tamukoh, H., 2019, December. High-speed synchronization of pulse-coupled phase oscillators on multi-FPGA. In *International Conference on Neural Information Processing* (pp. 318-329). Cham: Springer International Publishing.
- Pramanta, Dinda, et al. "YOLO real-time object detection on EV3-Robot using FPGA hardware Accelerator." (2024).
- Pramanta, Dinda, et al. "Client-server Communication using YOLO for Object Detection Results between PC and EV3-Robot." *九州情報大学研究論集= Bulletin Kyushu Institute of Information Sciences/研究論集編集委員会 編* 26 (2024): 15-24.
- ChatGPT. "Voice Assistant Pro." Accessed January 6, 2025. Available: <https://chatgpt.com/g/g-Wv5YoTNKq-voice-assistant-pro>.
- R. Hempel and D. Lechner, "ev3dev," 2023. Available online: <https://www.ev3dev.org/>, accessed on 30 January 2023. [Online]. Available: <https://www.ev3dev.org/>

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**Authors Introduction**

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He earned his Bachelor's degree from Telkom University in 2013 and completed both Master's and Doctoral degrees at the Kyushu Institute of Technology in 2016 and 2020. After a post-doctoral fellowship with NEDO, Japan, from 2020 to 2021, he is currently an Assistant Professor at Kyushu Institute of Information Sciences since 2021. His research interests include neural networks, hardware, and AI for educational applications.

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