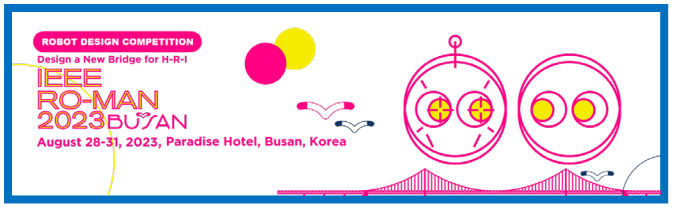
PO'ME: A Dog-Type Social Robot for Motivating Children's Reading Activities



Seungbin Jeong[1], Jin-young Moon[1],
Minjae Sung[1], YongSeop Kwon[2],
Hui Sung Lee[3*]

[1] Design, UNIST, sbjeong1@unist.ac.kr
[2] Creative Design Engineering, UNIST, yongseopkwon@unist.ac.kr
[3] Design, UNIST, huisung.lee@unist.ac.kr

This research aims to design a 'dog-type social robot' that helps children develop an interest in reading. It draws inspiration from the 'Read to a Dog' program, which has been implemented in the United States and the United Kingdom since 1999. The 'Read to a Dog' program utilizes interactions with a dog to enhance children's reading skills, boost their confidence, and reduce stress. This research intends to replace the dog with a 'dog-type social robot' to achieve cost reduction, improve safety, and extend the program's benefits to more children in different locations. The final concept design is formulated through the creation of user scenario, identification of robot behavior patterns, establishment of robot motion areas, conducting a preference survey for the robot's appearance, and visualization of the collected data. The subsequent stages involve the actual production phase, including design mock-up, working prototyping, and user evaluation.

1. CONTEXT

1.1 Current Situation and Problem Definition

The program 'Read to a Dog,' which involves children reading books to a dog, has been successfully implemented for over 20 years. According to multiple studies, it has been demonstrated to enhance overall improvement in children's reading abilities [1]. Additionally, it has been proven to boost self-confidence and facilitate stress relief. However, utilizing dogs in the program poses constraints in terms of management, cost, and safety, necessitating the exploration of alternative approaches that can provide similar benefits to a larger number of children at a reduced cost.

1.2 Hypothesis

In the field of education, social robots have been used as peers and friends to effectively drive learning outcomes [2] and studies have shown that children attribute mental, emotional, and moral qualities to 'pet robots' and perceive them as 'pets' rather than 'machines' compared to adults [3]. Based on this, developing a dog-like social robot that allows children to interact with the robot by seeing, hearing, and petting it would be a reasonable alternative to a real dog, combining the proven positive effects of 'Read to a Dog' with the management and cost advantages of a social robot.

2. SYSTEM PLANNING

2.1 User Scenario

The user scenario (Figure 1) consists of three main stages: the relationship-building stage between the child and the robot, the reading stage, and the concluding stage. For each stage, five possible cases were envisioned, and suitable interactions were explored for each case.

2.2 Behavior Patterns Extraction

Identifying the points of interaction between the child and the robot in the scenario, appropriate behavior patterns for the robot were established. Ultimately, referring to the unique behavior expressions of dogs known as 'calming signals,' a total of eight behavior patterns (neutral, intimacy, agree, disagree, curiosity, dislike, surprise, sad) were derived.

2.3 Motion Areas Set-up

The robot's body parts were determined to represent the eight behavior patterns. To prioritize expression of emotions and intentions, locomotion functionality was excluded, and the final decision was made to include the eyes (display), ears, head, and tail as the motion areas of the robot.

3. PREFERENCE SURVEY

3.1 Objectives

A user preference survey was conducted at a children's library (Figure 2) to examine the preferences of the target group concerning the shape, breed, size and color of the dog, which serves as the foundational design element for the dog-type social robot. The acquired data was applied to the design of the robot's appearance, aiming to enhance both its likability and usability as the final product— dog-type social robot.

3.2 Target User

50 children aged 8-9

3.3 Results

3.3.1 Breed Preference

Among the nine selected dog breeds considering popularity and visual diversity, the Pomeranian received 17 votes and was chosen as the most preferred breed by the target children.

3.3.2 Size and Color Preference

Regarding size preference, small dogs received 37 votes, making them the most favored size among small, medium, and large dogs.

Among the four colors known for their popularity (white, tan, black, spotted), spotted received 16 votes and emerged as the most preferred color.

3.3.3 Material Preference

Considering diversity, workability, and safety, a total of nine materials were presented, and fabric with a soft texture received 28 votes, making it the most preferred outer material.

4. FINAL DESIGN PROPOSAL

4.1 Idea Sketch

Based on the results of the preference survey and considering the considerations for each motion part, we conducted idea sketches (Figure 3) for the exterior

4.2 Final Design Concept Features

Based on the top-ranked breed preference, Pomeranian, we designed the exterior appearance. The head and back are made of soft fabric material to provide a pleasant touch for children when petting, while other parts are made of non-glossy plastic material. By utilizing the robot's parting lines, we combined white and brown colors to clearly depict the image of the most preferred spotted pattern. The eyes are covered with a curved transparent cover on top of an internal display, giving the robot's eyes a three-dimensional effect and protecting the display from damage (Figure 4). The robot's name is PO'ME, which is derived from the front letters of the dog breed 'Pomeranian,' serving as the robot's morphological motif. Additionally, the letters also represent the words 'Puppy robot, Optimistic, Motivating, Encouraging'.

4.3 Resolution of Structural Interference Issues in Motion Areas

For areas where interference occurs between the ears, neck, tail, and the rigid housing, we applied flexible materials such as silicone to ensure smooth movement without any issues in a wide range of motion.

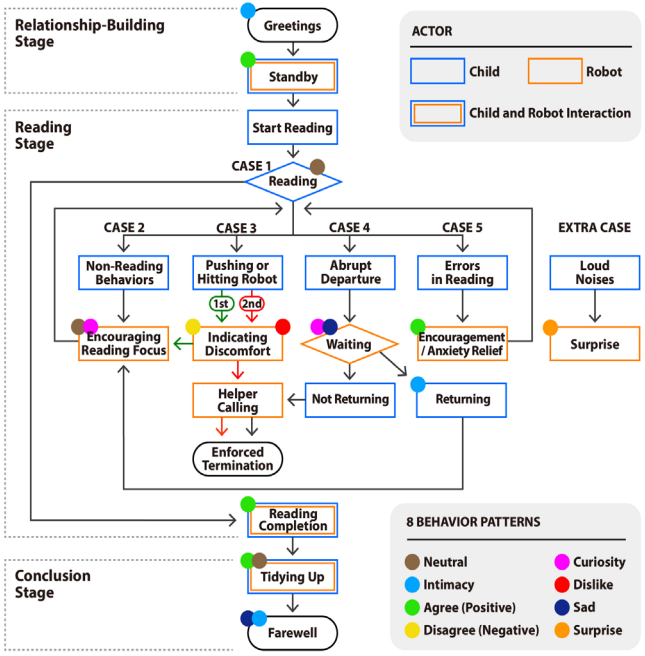


Figure 1. User Scenario

Figure 2. Preference Survey at Children's Library

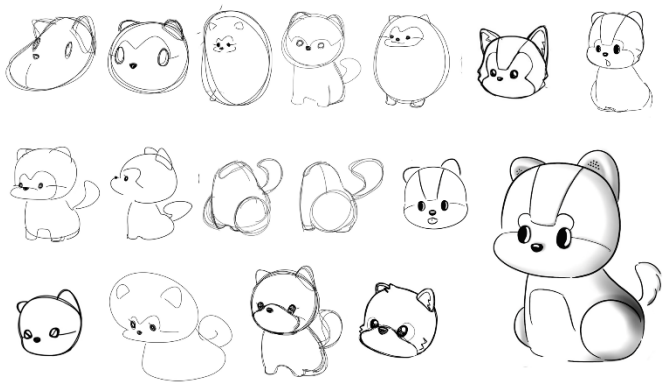
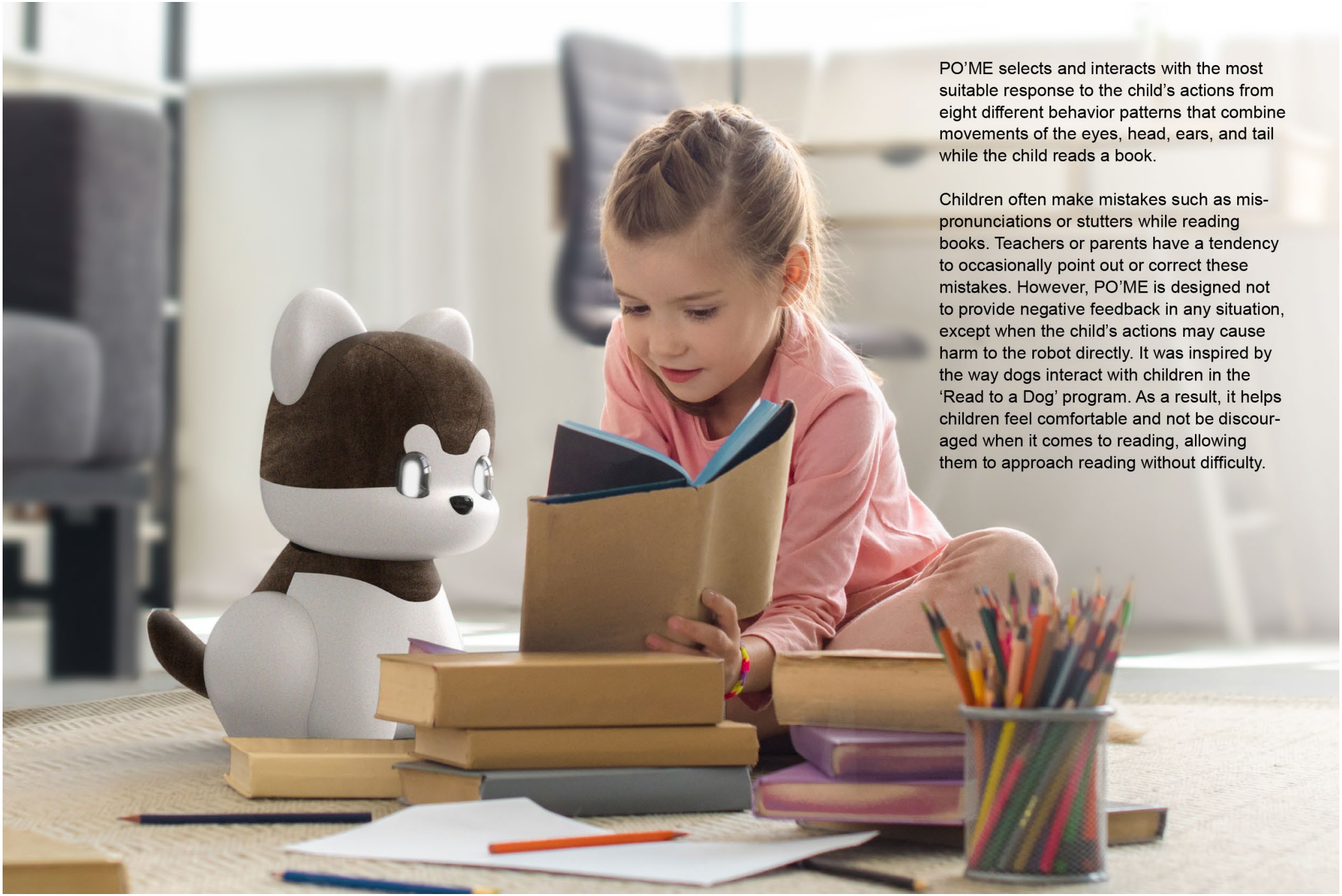


Figure 3. Idea Sketch

Figure 4. Final Design Proposal



PO'ME selects and interacts with the most suitable response to the child's actions from eight different behavior patterns that combine movements of the eyes, head, ears, and tail while the child reads a book.

Children often make mistakes such as mispronunciations or stutters while reading books. Teachers or parents have a tendency to occasionally point out or correct these mistakes. However, PO'ME is designed not to provide negative feedback in any situation, except when the child's actions may cause harm to the robot directly. It was inspired by the way dogs interact with children in the 'Read to a Dog' program. As a result, it helps children feel comfortable and not be discouraged when it comes to reading, allowing them to approach reading without difficulty.

Figure 5. Anticipated Usage Scene

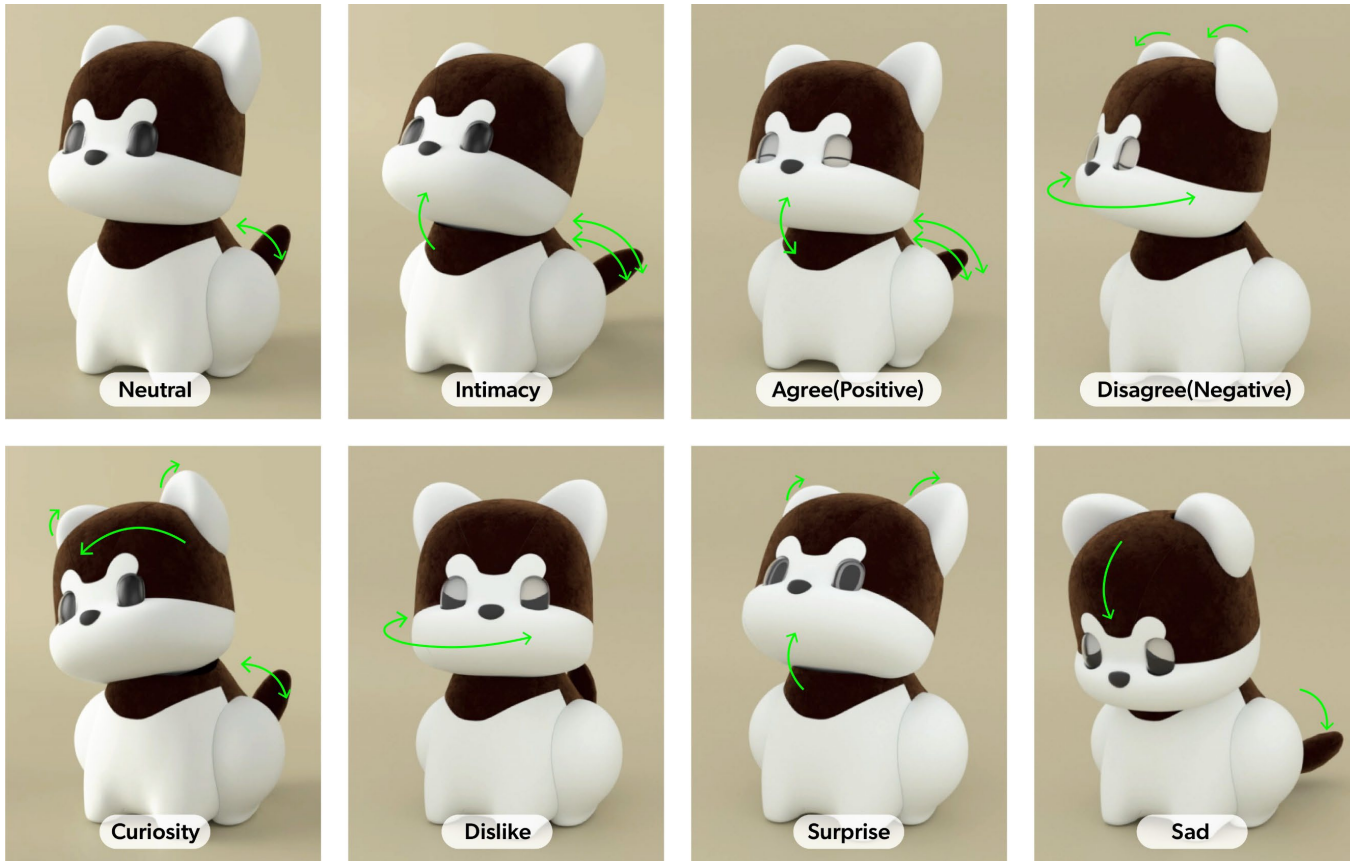


Figure 6. Behavior Patterns Simulation

Figure 7. Facial Expressions

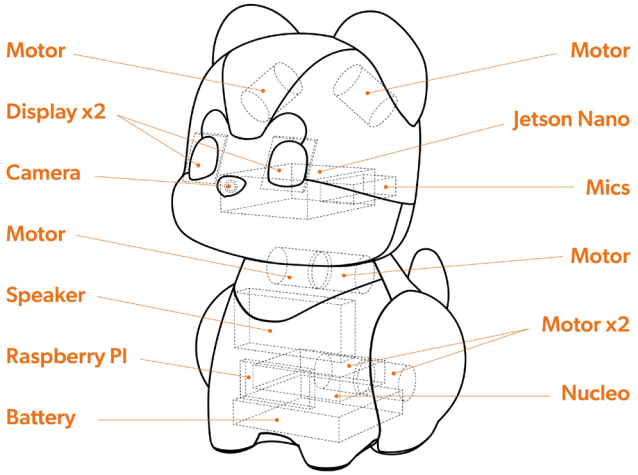


Figure 8. Embedded Hardware Placement

5. FUTURE WORKS

5.1 User Evaluation Using Simulation Videos

We plan to conduct user evaluations to verify if the PO'ME's emotional expressions through behavior patterns (Figure 6) and facial expressions (Figure 7) are effectively conveyed to the target users as intended.

5.2 Design Mock-up

To assess the overall aesthetics of PO'ME, including its size, color, and material appropriateness, a design mock-up closely resembling the physical product will be created.

5.3 Working Prototyping

Inside PO'ME, various hardware components such as input and output devices, motors, and batteries are integrated to enable physical interaction with children (Figure 8). After ensuring the reliability of the concept through preliminary work, a working prototype that closely resembles the final product will be developed for the purpose of conducting user evaluations.

REFERENCES

1. Marieanna C. le Roux, Leslie Swartz and Estelle Swart. 2014. The Effect of an Animal-Assisted Reading Program on the Reading Rate, Accuracy and Comprehension of Grade 3 Students: A Randomized Control Study. In Proceedings of the Child & Youth Care Forum volume 43, 655–673. https://link.springer.com/article/10.1007/s10566-014-9262-1
2. Tony Belpaeme, James Kennedy, Aditi Ramachandran, Brian Scassellati, and Fumihide Tanaka. 2018. Social robots for education: A review. In Proceedings of the Science robotics 3, 21 (2018), eaat5954. https://www.science.org/doi/10.1126/scirobotics.aat5954
3. Melson G, Kahn Jr P, Beck A, Friedman B, Roberts T, Garrett E. 2005. Robots as dogs?: Children's interactions with the robotic dog AIBO and a live Australian shepherd. In Proceedings of the CHI EA'05: CHI'05 Extended Abstracts on Human Factors in Computing Systems, 1649–1652. https://doi.org/10.1145/1056808.1056988