

# NEC Realizes Enhanced Version of its PaPeRo Robots



**NEC Corporation announced the development of a new advanced version of its personal partner-type robot "PaPeRo", PaPeRo 2005, which is capable of more natural communication with people principally due to improvements in its hearing ability even within noisy environments and to enhancements in cognitive ability regarding recognition of handwritten characters and images.**

With backing from the New Energy and Industrial Technology Development Organization ("NEDO"), NEC has been engaged in the development of a childcare robot as one application of its partner-type robot. It has thus developed "Childcare Robot PaPeRo" that boasts enhanced security features and functions enabling it to play with and watch over children. The Childcare Robot was developed by using one part of the technological functions of PaPeRo 2005 and in particular by focusing on interaction between the robot and children.

As a project commissioned by NEDO, NEC will begin use trials of its Childcare Robot, consisting of the robot interacting with children aged between 3 and 12 and technology demonstrations for the general public. These trials will take place at the Robot Fureai Room in the Robot Station area of EXPO 2005 AICHI, which is being held from March 25 to September 25 in Aichi, Japan.

Main features of the enhanced, high-performance PaPeRo, PaPeRo 2005, which incorporates NEC's own technologies, include the following:

1. Enhanced communication capabilities through improvements in various cognitive abilities
  - Equipped with eight microphones, the speech signal processing and recognition technology enable the robot to precisely locate the speech source, and also to recognize and understand commands in a noisy home environment or even while the robot itself is talking.
  - Handwritten-character recognition technology allows the robot to read handwritten characters, remember names, and calculate mathematical formulae.
  - Video recognition technology enables a variety of interactions such as recognition of waving hands and objects such as a moving pendulum.
2. Enhanced entertainment skills
  - Natural and enjoyable interaction between human beings and the robot were enabled by developing entertainment skills in collaboration with the Japanese comedian and entertainer, Zenjiro.
3. Enhanced links among robots and with other remote terminals via a network
  - Development of networking capabilities for improved connectivity among multiple robots, and between a robot and remote terminals such as a PC.
4. Performance improvement with new hardware
  - New hardware that boosts processing capability and scalability was developed to enable high-speed

execution of various new technologies.

Features of NEC's Childcare PaPeRo are as follows:

1. Enhanced communication capability targeted at children

- Speech recognition enabled in noisy environments such as nursery schools, kindergartens, and exhibition halls.

- Simultaneous speech recognition for multiple utterances with wireless microphones. The robot can recognize what is said by who out of simultaneous multiple utterances with the help of a special jacket worn by the child, which is equipped with a wireless microphone and an ultrasound transmitter.

- Nine touch sensors are mounted on the head and the body of the robot to achieve various interaction with children from a wide range of ages, including infants.

2. Enhanced cognitive abilities for recognizing active children

- Enhanced recognition of children's faces enabling precise identification of face direction and an enhanced database of children's faces. Precise face-direction identification is effective for locating children who can't keep still in front of a camera.

- An ultrasonic child locator that realizes location of a child with only an error of a few centimeters within the range of 5 meters by reception of the ultrasounds radiated from the special jacket worn by the child.

3. Enhancement of play functions that children never tire of

- These extended functions include singing along with the robot, chatting with the robot, face registration/recognition, robot quizzes, making greetings, connection with mobile phones, robot dances, and roll calls. Children can simply enjoy these functions, or use them to learn and experience various things.

4. Sufficiently safe to interact with children

- Reduced motor power, no-finger-catching design, proximity sensors, and bumper switches immediately stop the robot upon detection of contact, realizing safe interaction even with a three-year-old child.

- Enables remote child monitoring and conversation through the robot hardware such as its eyes, mouth and ears with the help of a mobile phone network.

There is great expectation surrounding the development of partner-type robots, which will be able to live with us and assist us in our daily lives. Although a variety of robots have been developed in response to such expectations, they still possess insufficient performance in terms of speech and image recognition, in addition to their interaction being monotonous and boring. Therefore, development of a robot, which enables natural and enjoyable communication, as well as a wider variety of interactions, has been highly sought after and desired.

With its enhanced functions, PaPeRo 2005 has overcome the performance obstacles that the conventional PaPeRo possessed, and provides new experiences through various human-robot interactions that are filled with fun and humor.

In addition, Childcare PaPeRo, which will be presented at the EXPO 2005 AICHI, has been developed to specialize in interactions with children who have strong needs for robots. NEC will continue to improve the robot's interaction capabilities with children throughout the period of the EXPO.

NEC believes that the development of PaPeRo2005 and Childcare PaPeRo, as well as the demonstration and verification of their technology at EXPO 2005 AICHI, will lead to a wider range of robot capabilities, higher performance, and development of new applications. NEC will continue its research and development of intelligent robot technologies as well as their applications to achieve commercial viability. In response to customers' demands to make better products, these new technologies are planned to be incorporated into the robot software platform, RoboStudio, which is currently marketed by NEC System Technologies.

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