

Combating the Gray Dawn: Japan's Robot Strategy

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21 April 2019

Word Count: 1458

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While fertility rates rapidly decrease and life expectancy increases around the world, the percentage of elderly in the population continues to grow. When the world population reached 7 billion in 2012, people aged 65 and above comprised 8.0%, 562 million, of the world population, but a study conducted by the United States National Institute of Health projects that by 2050, the proportion of elderly will grow to 17%, or 1.6 billion (Wan He, et al., 2015). However, the aging phenomenon is not even across all regions; Asia currently contains over half of the world's elderly, and by 2050 this number is expected to grow to two-thirds. In Japan, over one-fourth of the population is aged 65 or older, and this number is only expected to increase to one-third by 2036. Given the low fertility rates and increasing life expectancy, Japan's overall population is shrinking while the proportion of elderly citizens continues to grow.

These senior citizens need care and nursing, but due to Japan's extremely low fertility rate of 1.44 births per woman, it is no longer viable to rely on children and grandchildren to take care of them, and the dwindling labor force will be unable to sustain the needs of Japan's aging population. Japan's Health, Labor, and Welfare Ministry estimates that there will be a shortage of approximately 380,000 nursing care workers by 2025, and though Japan has taken steps to allow foreign workers to immigrate to the country as caregivers, obstacles such as the language barrier have prevented the policy from gaining much traction (Foster, 2018). The government has instead turned towards another solution: robot caretakers, which can provide physical assistance as well as companionship to Japan's elderly citizens. The Japanese government has allocated one-third of its budget to fund research and development of robots to aid its senior citizens. According to Japan's robot strategy, the country hopes that the use of robots will

mitigate the amount of stress and workload on caretakers and allow them to be more efficient (Ministry of Economy, Trade and Industry, 2015).

One category that it is focusing on are physical assistance robots, which include both lifting and mobility aids. Honda's Walking Assist, for example, is a mobility aid that wraps around the legs and backs of people with weakened leg muscles, helping them move on their own. Another mobility aid is Tree, which uses a video screen to show users where to place their next step and provides balance support. Panasonic's Resyone, which is a transfer assist bed that transforms into a detachable wheelchair, facilitates easier transportation of elderly citizens (Foster, 2018).

Moreover, researchers and developers are also focused on lifting aids. A study published in the *Journal for Clinical Nursing* found that caregivers often suffered from back pain due to the stress of lifting and carrying elderly patients (Iwakiri et al., 2019). To alleviate this problem, developers have designed devices to help caregivers with this task. Wearable devices include Cyberdyne Inc's Hybrid Assistive Limb (HAL), which is an exoskeleton that serves as back support to caregivers. An example of an autonomous lifting aid is Robear, which is a bear-shaped caretaker robot designed to help lift elderly patients out of beds and into wheelchairs and assist them with standing up. In order to accomplish this task, it uses tactile sensors that allow it to have a gentler and more precise touch.

It is also hoped that robots could help caregivers perform basic tasks. Honda, for example, developed Asimo, a four-foot tall humanoid robot that looks like an astronaut. Asimo can perform simple tasks such as turning off the lights, opening doors, and carrying objects due to its complex tactile sensors. For example, its force sensors let it know how much force to apply when picking up a tray versus shaking a person's hand, as well as recognize when to adjust the

amount of force, such as adding more when pushing a cart up an incline. Using its advanced vision algorithm. Asimo can recognize faces and follow voice commands, enabling it to greet familiar users.

In addition to physical assistance carebots, engineers and researchers are also working on the development of socially assistive robots (SARs). SARs use a combination of traditional tactile sensors and combine them with emotional intelligence technology to allow them to carry on conversations and interact with humans. Developers hope that they can serve as social stimulation and interaction for senior residents, especially those who suffer from dementia. Pepper, which was developed by Softbank Robotics Corp., is an emotionally intelligent humanoid robot that can analyze facial expressions, tone of voice, and body movement to identify how the person it is conversing with is feeling. It can differentiate between the nuances of human emotions, such as between a smirk and a smile. Understanding these emotions enables Pepper to hold more meaningful interactions with humans. In Japan's nursing homes, Pepper is being used to lead games and exercise routines, as well as hold everyday conversations. Palro, another humanoid robot, is also being used as a social companion in nursing homes. It can sing, dance, and interact with humans, leading recreational activities.

On the other hand, other developers have turned towards making robots that can serve as pets. Paro, an interactive therapeutic robot seal designed by Japanese company AIST, attempts to replicate the effects of animal therapy with a robotic alternative. Paro has tactile sensors that allow it to respond to touch, light, temperature, and sound. Paro behaves like a real baby harp seal—it cries if hit and purrs if stroked, and its light sensors let it know when it should be asleep and when it should be awake. Additionally, Paro can learn its name and other words that its owner uses frequently. Likewise, Sony's robot dog, Aibo, has also been deployed in senior

nursing homes as a robot therapy solution. It can do tricks and interact with humans like a real dog, using its ears, tail, body movements, and voice to express emotion. It has artificial intelligence capabilities that allow it to develop a personality over time, in addition to facial recognition technology.

Researchers conducted a randomized control trial with dementia patients in senior nursing homes and found that interaction with Paro generally reduced symptoms of agitation and depression in participants. Some of these benefits were attributed to the stress-reducing action of stroking Paro, but the researchers speculate that the positive group setting in which the therapy sessions were held increased social interaction between patients (Rokstad et al., 2015). This research was corroborated by a study published in *Frontiers in Aging Neuroscience* (Takayanagi et al., 2015). Researchers of that study found that Paro served as an icebreaker between people, initiating conversations and stimulating social interaction. Furthermore, a research team with the Japan Agency for Medical Research and Development also found that using robots in nursing homes had a positive effect on the residents. The study included a total of about 900 seniors, and rough 1,000 different robots, including Pepper and Paro. They found that by interacting with the robots, 34% of the participants showed an improvement in physical activity. (Obayashi et al., 2018)

Moreover, the introduction of carebots has been well-received in Japan. A 2018 survey conducted by Orix Living Corp., a Tokyo-based elderly care company, found that over 80% of the respondents were open to receiving care from robots (“Over 80% of Japanese Positive”). The company surveyed 1238 men and women aged over 40 across Japan. The results found that 13.1% of the participants were eager to be assisted by robots, and an additional 71.2% would be open to carebots if recommended to them. Only 14.7% of the respondents were opposed to the

use of robots. This is the most positive reception to robots since the study was first conducted in 2011. Even at the lowest rates, around 74% of the participants were open to robot care.

Overall, the use of robotics in senior care may be a viable solution for the caretaker shortage in Japan. Physical assistance robots can mitigate the physical stress on caregivers, and studies have shown that interacting with social assistive robots improves elderly patients' mental and physical health. Although the field is currently small, as robots are becoming more commonly used and widely accepted, there is potential for it to grow into a large, thriving market. Currently, carebots are extremely costly and relatively undeveloped, but rapidly improving and advancing technology may mean that these robots will soon be more accessible to all people. While it is clear that carebots cannot be the only solution for taking care of Japan's growing senior population, they are a step in the right direction. Together with human care and assistance, society may be able to relax knowing that their elderly loved ones are in good hands.

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