The research results of students of the Graduate School of Systems Design

Introduced to a famous online journal

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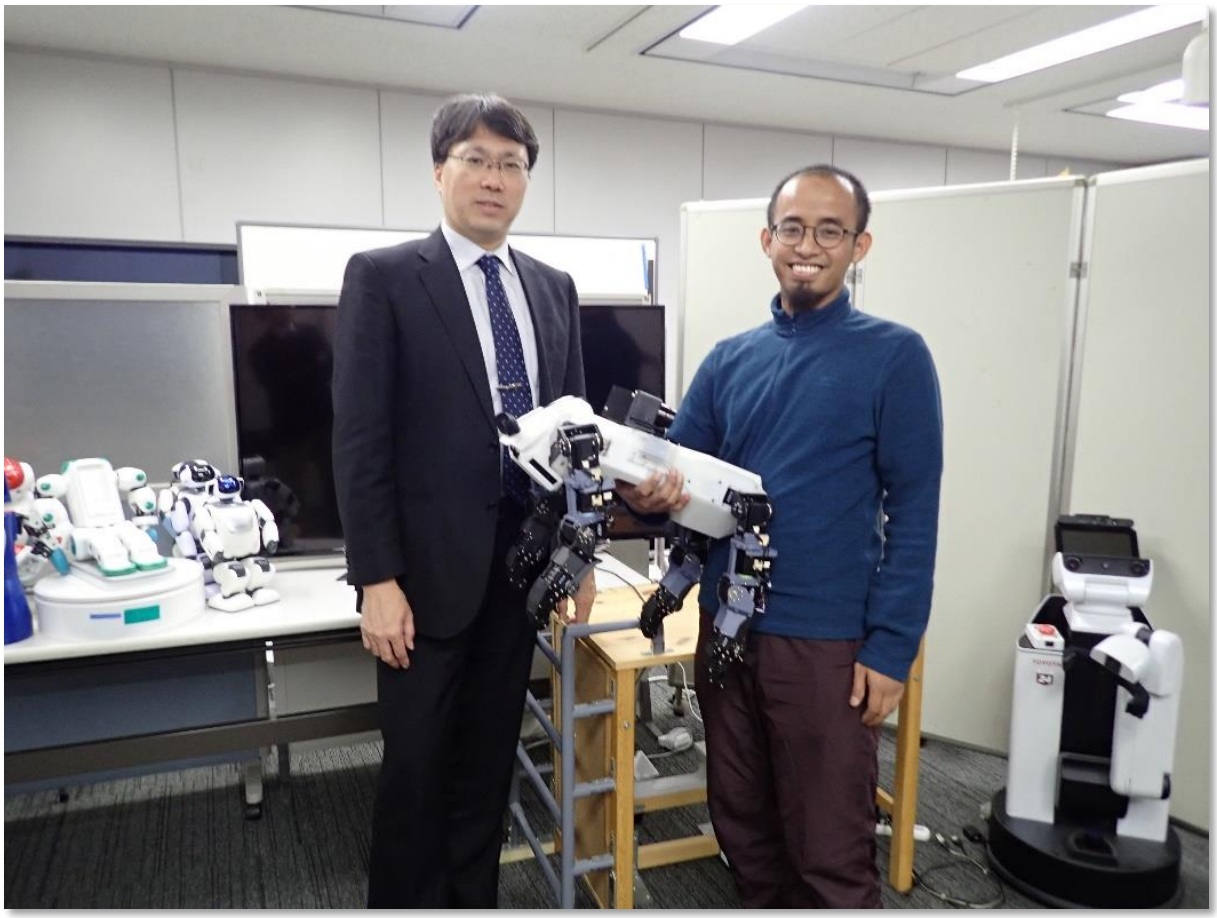


◇　Prof. Naoyuki Kubota・ Azhar Aulia Saputra

The research results of Azhar (Azhar Aulia Saputra), a second-year doctoral student at Tokyo Metropolitan University, were published in the online journal IEEE Spectrum Online. Mr. Azhar is an international student from Indonesia who belongs to Kubota Laboratory in the Department of Mechanical Systems Engineering. The contents of this article are about quadruped robots (cat-type robots) jointly developed by Mr. Azhar with Yuichiro Toda (currently assistant professor at Okayama University, after having worked as a special assistant professor at Kubota Lab. in a JST research project (ImPACT)). It was published on IEEE Spectrum Online and has been listed on multiple media, such as Business Insider.

As a public relations representative, I had an interview with Professor Kubota and Azhar to let everyone know about the progress of this.

※1　IEEE Spectrum

The world's most widely read electronics magazine has been published in 400,000 copies.

※2　ImPACT(Innovative Research and Development Promotion Program / Japan Science and Technology Agency)
Professor Kubota, Department of Mechanical Systems Engineering, Is in charge of Robotic Intelligence at the "Tough Robotics Challenge" at ImPACT.　URL:https://www.jst.go.jp/impact/program/07.html

※3　Business Insider
Websites for Business and Technical News (Nov 28, 2019, 2:25AM)
URL : https://www.businessinsider.com.au/watch-this-robot-dog-climb-ladders-2019-11

Q Please tell us about the features of the robot introduced in IEEE Spectrum this time again.

The robot has been facilitated by many sensors for perceiving the robot's situation, such as movable two-dimensional range sensors, touch sensors, force sensors, and IMU sensors. The robot also provides mechanisms for moving in rough terrain and climbing and descend ladders. Complex systems are built into the system. Furthermore, It has a cognitive model based on AI that can detect objects and ladders and locate them. The robot also has ability to climb vertical ladders with a limited mechanism, making new and unique movements. The movable two-dimensional range sensor can be used to see 360 degrees, and a three-dimensional map of the outside world, including ladders, is built as a topological map, and an action plan is carried out while identifying one's position and posture. In addition, it is possible to place and grip even moving things such as swaying ladders.

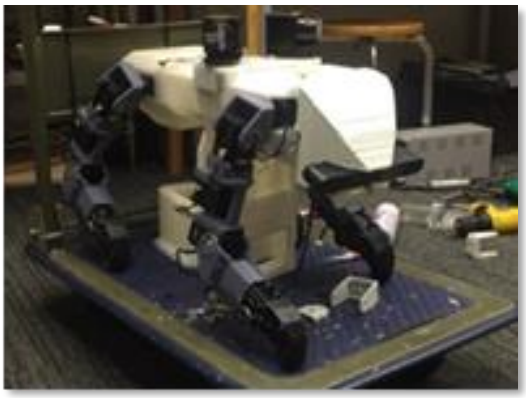
◇ The novel model of the robot design is that the front arm and clawing mechanism. By supporting the body with the front limb and grasping mechanism, it was able to climb the vertical ladder.

Q Please tell us the motive and trigger of making this robot.

His research was first initiated by the development of a SLAM that simultaneously performs self-position estimation and environmental mapping. We developed a movable two-dimensional range sensor for object recognition. After that, we decided to create a quadruped robot with advanced cognitive and behavioral abilities to demonstrate its effectiveness in a variety of complex environments. This project was exciting because it was perfect for my skills, specialty, and interests.

Q What were your hard work during the development and the points you were particular about ?

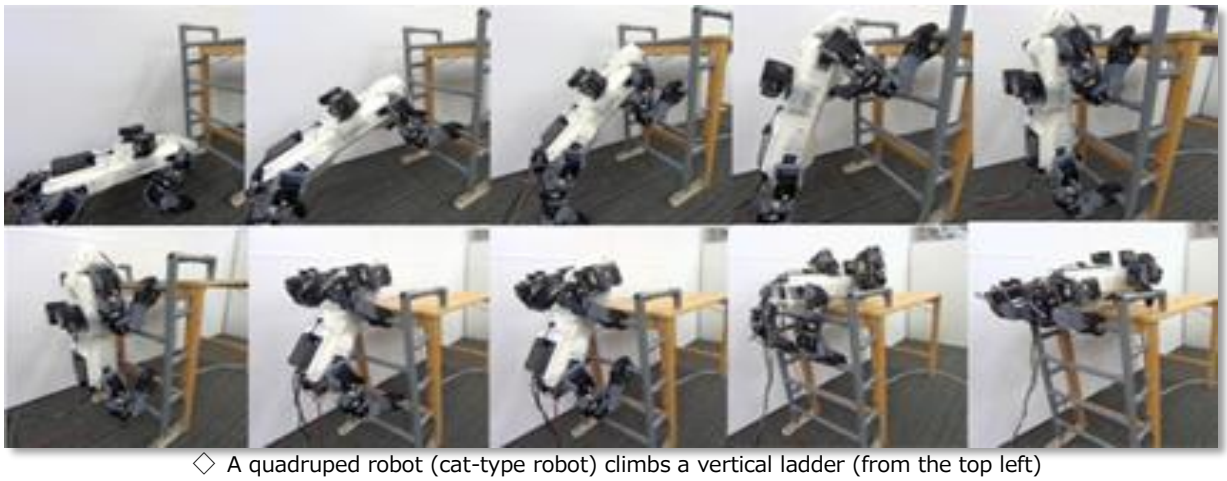
The difficult point was the integration of various sensors mounted on the robot, and compromising noise and disturbance. It was necessary to consider the size, weight, and accuracy limitations of mechanical parts and sensors, and how to generalize and handle various environmental conditions was also a challenge. Currently, I am trying to create an action model that can adapt to any environmental condition.

◇ Robot in prototype

Q Please tell us about future developments (possibilities for social implementation).

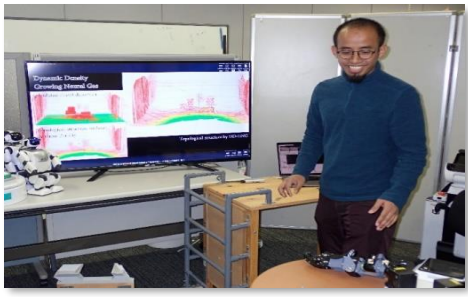
Since the robot has advance environmental cognitive skills and diverse mobility skills, it has potential to be developed and applied into many fields, such as entertainment and social support. It can be used to evaluate the disaster situation, not only to play an active role in disaster areas and dangerous places. It also can be expected as a human-friendly robot. In the future, I think that it can become a robot like the existence of a pet dog for home use. Currently, research and development of quadruped robots are thriving worldwide. We will do our best to compete with the research teams of MIT (Massachusetts Institute of Technology) and DARPA (Defense Advanced Research Institute).



◇ A quadruped robot (cat-type robot) climbs a vertical ladder (from the top left)

Q Why did you decide to do robot research at Tokyo Metropolitan University?

My supervisor at a university in Indonesia is from Kubota Lab. I have been recommended by him to join the Kubota Lab. Furthermore, the university has a good reputation, and Kubota lab research is suitable for my interest. I study robotics because I like to design and develop the robot.

◇Mr. Azhar had been a team leader at the World Humanoid Robot Competition in Indonesia and became a semi-finalist. His team was not able to make it to the final because of an unfortunate trouble of the robot failure It is said that, however, the winning feared contestant

Q What was good about entering Tokyo Metropolitan University ?

There are many wonderful professors at Tokyo Metropolitan University who have been doing excellent research. In addition, management are also firm. From experimentation to sports, there are many excellent facilities to improve students' skills.

◇ He is currently studying his Doctoral student under JSPS Research Fellow. After entering the university in 2014, the most impressive thing was the publication of a paper in a magazine with a high impact factor. He is a father of two children and lives a fulfilling life in Japan.