

Development and technical demonstration of Japan's first and world's smallest lunar robot, SORA-Q

Transformable Lunar Robot Team (SORA-Q)

Case Overview

The team developed SORA-Q, an ultra-compact and lightweight robot capable of stable lunar surface travel and autonomous control, by effectively integrating toy technologies and IoT devices, image sensors, and image processing technologies that had not previously been used in space with related space technologies. SORA-Q was installed on the Smart Lander for Investigating Moon (SLIM), which achieved Japan's first lunar landing, and accomplished the world's first "fully autonomous" lunar exploration. SORA-Q also captured and transmitted images of SLIM's post-landing condition and the surrounding environment, making a significant contribution to the success of the lunar landing mission.

Key points regarding receiving the award (Comments from the selection committee)

It is highly commendable that a toy manufacturer from a non-space industry entered the space sector and delivered significant results, thereby greatly broadening the range of companies participating in space development.

The technology that automatically selects and transmits the optimal image from multiple shots is highly commendable and will be valuable for future space data utilization. The widely reported image of the SLIM in an unexpected landing orientation, received on Earth, also helped raise public interest in space.



Image of SLIM and its surrounding environment captured and transmitted by SORA-Q on the lunar surface

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Concrete Results

1. Contribution to creating new areas for space development and utilization

- The ultra-compact exploration robot capable of stable mobility after deploying wheels and stabilizers on the lunar surface was developed by focusing on miniaturization and lightweight technologies as well as transformation mechanisms cultivated in the toy industry. This enabled an exploration system that can be mounted on spacecraft with strict payload constraints using minimal resources.
- Leveraging the mission opportunity of the SLIM, it demonstrated technologies for lunar surface mobility, imaging, and data transmission using a fully autonomous robot that combines toy technology and commercial products. Through this space demonstration, the team gained development expertise and exploration technologies applicable to future lunar and Mars exploration, as well as the construction of crewed lunar bases.
- Images of the SLIM captured by SORA-Q were used to evaluate the accuracy of pinpoint landing technology and to support post-landing scientific observation operations, making a significant contribution to the success of Japan's first lunar landing mission.
- Beyond the space sector, it promoted Dual Utilization aimed at addressing social issues on Earth and enhancing industrial competitiveness, presenting a new model for space development and utilization. The lunar demonstration also highlighted the functionality and reliability of Sony's microcontroller boards, supporting wider product adoption.

2. Contribution to expanding the space development and utilization market

- At Doshisha University, a total of more than 30 students engaged in lunar rover research, with nearly 10 going on to work in the space industry. By continuing to participate in joint research with JAXA and in the Moonshot Project, these students have sustained meaningful contributions to space development.
- Following the lunar demonstration, Sony Group's microcontroller boards became widely recognized as a Japan-developed IoT development platform, leading to increased B2B inquiries.
- The space-qualified SORA-Q has attracted inquiries from international space agencies, including NASA, indicating strong potential for deployment in global space missions.

3. Contribution to the advancement of the economy and society

- The toy of SORA-Q released by TOMY Company, Ltd., "SORA-Q Flagship Model," sold out following the lunar demonstration, prompting additional production and the launch of related products, including Tomica Premium SORA-Q & SLIM, contributing to increased brand recognition and revenue growth in the consumer market.

- The lunar demonstration verified the low power consumption and reliability of the microcontroller board, and expanded its application in robotics by demonstrating use cases in AGVs (automated guided vehicles), drones, industrial equipment, and construction machinery.
- As a practical example of Dual Utilization, the project demonstrated the potential for technology transfer from space exploration to terrestrial industries, highlighting opportunities for broader market expansion.

4. Contribution to technology

- Successfully demonstrated lunar-surface exploration using an ultra-compact robot incorporating toy technologies and commercial products, acquiring development expertise applicable to future space missions. In particular, the team established exploration technologies related to mobility, image processing, communications, and autonomous control, with strong potential for large-scale, distributed exploration using multiple small robots.
- This project represents the first successful lunar demonstration through open innovation, serving as a model for future science and technology innovation.
- To maximize impact, results were actively disseminated through international conference papers, websites, social media, and press releases, promoting the sharing and broader adoption of technical knowledge.

5. Contribution to promoting public understanding and human resource development

- Lunar surface image of SLIM captured by SORA-Q was released through press conferences and press releases, widely sharing the results of Japan's first lunar landing and enhancing public interest and awareness of space development and utilization.
- The toy version of SORA-Q closely replicates the materials, size, and transformation mechanism of the flight model, enabling users to experience exploration missions at home via a mobile application. It also serves an educational role by fostering children's interest in the natural sciences.
- The toy version of SORA-Q has been distributed to over 100 educational institutions and featured in more than 70 lectures. It has also been introduced in Sony's ongoing workshops for primary and secondary students using microcontroller boards, creating learning opportunities in AI and robotics and promoting STEM education for future scientific and technological talent.
- SORA-Q has also been exhibited internationally, including at the Science Museum in the UK and CITE DE L'ESPACE in France, disseminating its results both domestically and internationally.

