Technical Inventiveness | DOI:10.1145/3589949

# Fusing Creativity and Innovation in Asia's Manufacturing Industry

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JST ERATO "KAWAHARA Universal Information Network Project" is a unique research program that unites researchers in the fields of human-computer interaction (HCI), robotics, and electrical engineering in Japan.[1] The program aims to explore the technologies needed for the next generation of the Internet of Things and HCI.

The program's cross-disciplinary approach has brought unique research results through collaboration among different fields. Since the Asian region, including Japan, is a unique global manufacturing hub, this crossroads brought together experts from various fields of manufacturing, including top fashion designers, architects, and manufacturers of building machinery and materials.

One such notable success story is found in wireless power transfer technology. We devised a new structure called the Multi-mode Quasistatic Cavity Resonator to create a space that can transmit tens of watts of power anywhere in a three-meter square room.[2] The key to this new structure is the resonance conditions that allow the walls, floor, and ceiling of the room to operate as low-loss power transmission resonators that are computationally determined. As a result, it is possible to generate a three-dimensionally distributed AC magnetic field that fills the entire room. We also developed Meander Coil++, a garment that can feed several watts of power to a device on the body by designing a knit with low-loss coils arranged in a zigzag pattern to reduce the magnetic field in the body.[3] Our access to an automatic knitting machine is an important component of this invention.

Typically, research in this field has been focused on electrical engineering. However, the project explored the human experience of wireless power transfer and considered how to create a system that blends into the environment seamlessly and without discomfort, as a part of building materials or clothing. This user-centered approach represents a departure from traditional technical-focused research and has the potential to greatly enhance the usability and convenience of wireless power transfer technology.

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*Discovering the importance of softness.* "Softness" was also identified as a key technical challenge for future robots during a project discussion. Developing soft robots required a unique control method and new materials. One example of this is the "pump-less" phase-change actuator, which uses a circuit printed on a sheet less than one millimeter thick to slowly contract and produce a force. The liquid that was key to the realization of this actuator was not for robotic use, but a material used for cleaning and cooling semiconductors. We have also developed a caterpillar-shaped soft robot that can move freely in places, such as on thin branches or wires, using a theory inspired from a real caterpillar.

*Poimo, a soft inflatable mobility vehicle in harmony with people and the environment.* The personal mobility vehicle "poimo" is the embodiment of the three themes of "energy," "actuation," and "fabrication." It is a next-generation vehicle for travel within a short distance. One of the key features of the poimo is that it can be easily deflated and made compact for transportation when not in use. The body of the poimo is made of a balloon-like chamber that is constructed using a drop-stitch structure. This allows the body to be soft and flexible, while still being strong and durable.

Poimo was designed to be a truly personalized vehicle, but because of its

**Multi-mode Quasistatic Cavity Resonator uses a room's walls, floor, and ceiling as low-loss transmission resonators to send tens of watts of power anywhere in a three-meter square room.**

light body, it is essential the body design take the rider's center of gravity into account. To this end, we developed a design tool that allows users to create a vehicle that fits their size simply by posing for a ride. The sofa type was well received by those who test drove the vehicle. Because of the spread of COVID-19, we received many inquiries from overseas as well. The idea's prototyping and customization would not have been possible without the cooperation of manufacturers who use the same material to make other products, including inflatable surfboards.

## Conclusion

It can be difficult to establish shared technical objectives in a project involving a diverse group of stakeholders. However, we have discovered that having a shared vision for the future and a united approach to technology can lead to the development of unique technical innovations. The national project concluded in March 2022, but implementing it in the real world presents a new challenge for the project members.


**References**

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