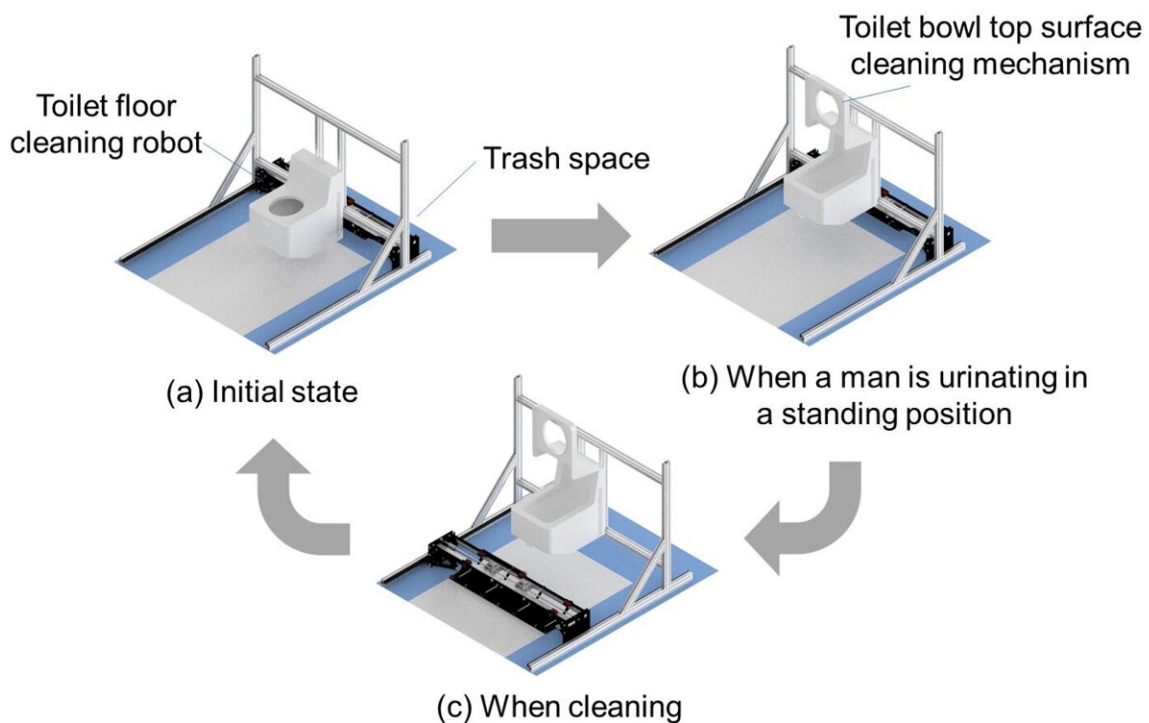


An automated system to clean restrooms in convenience stores

October 28 2022, by Ingrid Fadelli



Rough image of cleaning operation. Credit: Tezuka et al.

Researchers at Tokyo Metropolitan University have created a robotic system that could automate the cleaning of restrooms in convenience stores and other public spaces. This system, introduced in a paper published in *Advanced Robotics*, will be competing in the Future

Convenience Store Challenge (FCSC) at the World Robot Summit (WRS), a competition for state-of-the-art technologies to automate convenience stores.

"Many [convenience stores](#) provide restrooms for customers, and restroom cleaning is an essential part of the business," Kazuyoshi Wada, one of the researchers who developed the system, told TechXplore.

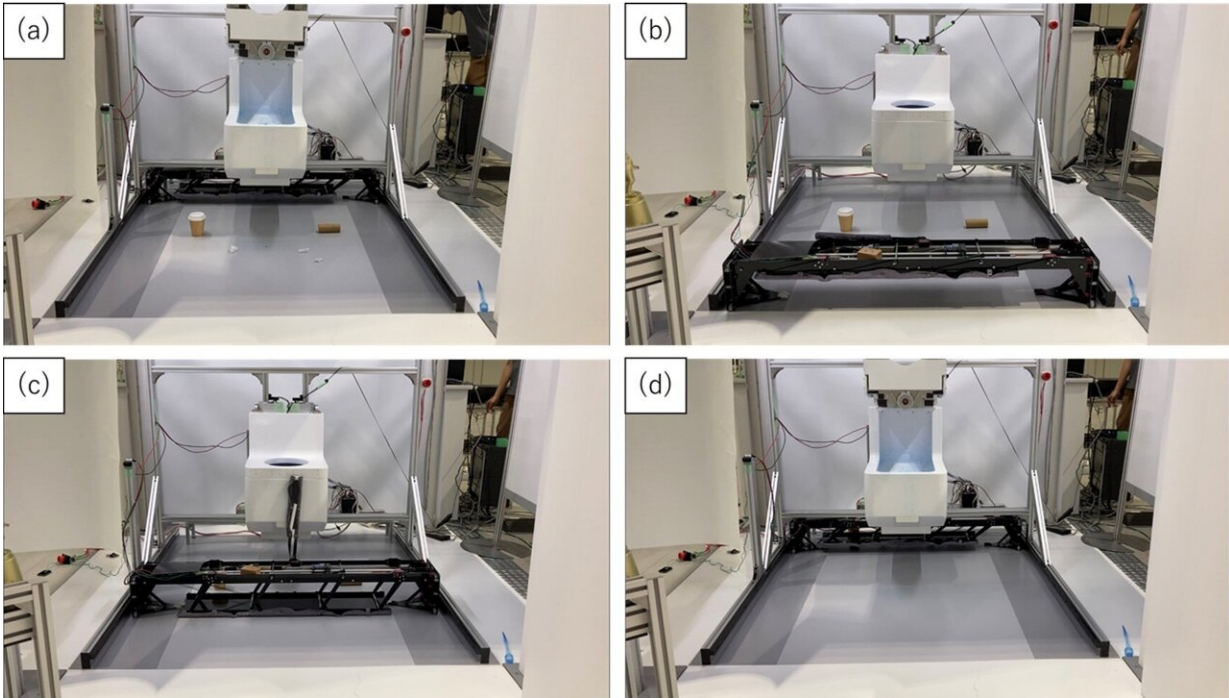
"While restroom cleaning is necessary for sanitary purposes, it involves mental and physical hard work. Clerks are often inappropriate for cleaning toilets in convenience stores; and maintaining consistent cleanliness levels is difficult because of the different perceptions of cleanliness among clerks."

The WRS established the FCSC competition to encourage the development of new technologies that could enhance efficiency in convenience stores. Robotic systems that can autonomously clean restrooms and toilets could particularly help to improve hygiene, while simplifying the work of shop clerks and convenience store cleaners.

"Our system will compete in the FCSC, with a view to applying it in real-settings in the future," Wada said. "The system consists of a toilet bowl top surface cleaning mechanism, a toilet bowl lifting mechanism, and a restroom floor cleaning robot. By robotizing the restroom space itself, the system aims to streamline the cleaning operation and achieve accurate cleaning in a short time (less than 20 s)."

While the researchers' system is cleaning a restroom, toilet bowls are automatically raised and a floor cleaning mechanism (stored behind the bowl) moves to the area in front of the toilets. Subsequently, a cleaning tool with water-absorbing sheets is deployed and starts wiping the floor and sides of the toilet bowl, while simultaneously collecting any garbage on the floor. As the cleaning tool cleans the floor, a device built into the back of the toilet seat cleans the toilet rim.

"The most unique feature of this system is that it uses a mechanism that allows the toilet bowl to be raised or lowered," Wada said. "The toilet bowl is lifted to the height of a man's crotch to reduce the scattering of urine and create space for floor cleaning."



How the system actually works: (a) Initial state (b) Automatic cleaning toilet bowl cleans over the rim. The floor cleaning robot moves to the front of the toilet space. (c) The floor cleaning robot collects urine and debris scattered on the floor while also cleaning the sides of the toilet bowl. (d) Cleaning is complete. Credit: Tezuka et al.

Wada and his colleagues tested their system in a series of experiments, where it was expected to clean fake urine and garbage. They found that it performed remarkably well, completing individual cleaning tasks in approximately 17s and removing 97.8% of the urine-like liquid.

In the future, the researchers hope that their system will be commercialized and implemented in real convenience stores. In addition, the toilet bowl lifting mechanism they designed could inspire the creation of similar restroom cleaning systems.

"We believe that our work could lead to the development of a new market for toilet spaces with cleaning systems," Wada said. "In our current system, the cleaning equipment is replaced with every cleaning, which is unrealistic for actual store use. To address this issue, we now plan to implement a function that allows cleaning equipment to be cleaned each time or replaced with a new one in the future."

More information: Sota Tezuka et al, Development of a restroom cleaning system for convenience stores, *Advanced Robotics* (2022). [DOI: 10.1080/01691864.2022.2130710](https://doi.org/10.1080/01691864.2022.2130710)

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