



WRS Future Convenience Store Challenge Preliminary Competition 2018

Task: Toilet Cleaning

Rulebook

2018/8/27

Revision History

August 27, 2018

- Added information regarding the number of participants for the renovation task
- Added information regarding the simulated urine and spraying
- Added information about floor materials
- Added information regarding the ceiling

February 2, 2018

- Added information about energy saving.

January 15, 2018

- First Draft

0. Terminology

Term	Definition
Mobile Robot	A robot that can move autonomously.
Infrastructure (Robot)	Unique infrastructure that can be installed inside convenience stores to assist in the robot's tasks. This equipment includes markings, IC tags, sensors, actuators and auxiliary tools that add equipment to products. Infrastructure made up of sensors and actuators can also be seen as stationary robots.
Manipulator	Robot arms, end effectors and other equipment that execute operations which can be installed on a mobile robot or as part of the infrastructure.
Product	Products found at a convenience store.
Customer	Person who visits the store to purchase products.
Container	Container used to hold and transport multiple products. A container may also be called "carton."
Product Display Area	Section of the convenience store with display cases or bookshelves installed.
Cashier Area	Section of the convenience store with the cashier counter installed.
Restroom Area	Section of the convenience store with the toilet installed (Abbreviation: Restroom).
Aisle Area	Section of the convenience store for customers and mobile robots to come and go (Abbreviation: Aisle).
Backyard Area	Area of the convenience store where customers are not allowed (Abbreviation: Backyard).
Home	Standby station of the mobile robot. The standby station is located in a designated place inside the backyard area.
Display Case A	Case for displaying products. There are no products placed in this display initially.
Display Case B	Case for collecting disposal items. Multiple products are mixed in this case initially.
Disposal items	In the Disposal task, those products that the judges set to be disposed.

1. Overview

This challenge aims to develop technology to automate the restroom cleaning task, which is a daily task for employees at a convenience store. Participants of this competition task will develop a robot that operates autonomously and performs cleaning operations, as well as infrastructure to perform cleaning operations that can be installed inside of the restroom area. In this challenge, participants will use the robots and infrastructure they develop to compete performing a demonstration of cleaning a toilet and the floor of a simulated restroom space.

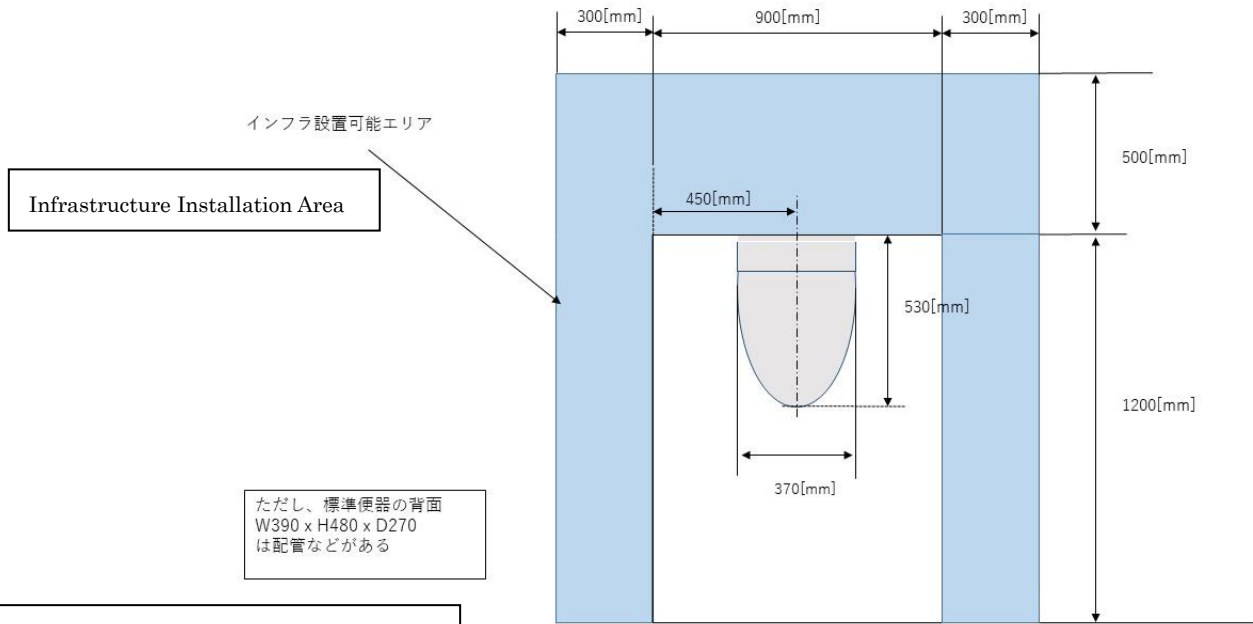
The restroom area consists of a toilet, floor and an area to install infrastructure in the layout shown in Figure 1.

The demonstration will consist of the following two subtasks:

- Cleaning simulated urine on the toilet. The rim (top of toilet bowl), the toilet seat (when up), and the floor around the toilet should be cleaned. The inside of the toilet bowl does not need to be cleaned.
- Cleaning garbage scattered on the floor (roll and scraps of toilet paper).

A comprehensive explanation about the cleaning will be described in the following sections.

In addition, the proposed system must contribute to energy saving in general or to the reduction of the staff workload that leads to energy saving in convenience stores.



Note: The backside of the toilet bowl (W390 x H480 x D270) has pipes and other fixtures.

Figure 1: Layout of Restroom Area

2. Flow of the Round

The time limit for this task will be 20 minutes. The task will proceed in three phases with the following order:

- (1) Renovation time
- (2) Setting time
- (3) Cleaning demonstration

The total amount of time for (1) to (3) is 20 minutes. Participants can distribute the time to each phase as they prefer. Participants must indicate their progression to the judges when starting each phase and when completing the task.

2.1. Renovation time

Participants will install their infrastructure inside Infrastructure Installation Area. Participants should inform the judges when they finish their renovations or if renovations are not required.

For this task, a maximum of 10 team members may enter the store.

2.2. Setting time

Participants will set up their mobile robot. Participants will place the mobile robot to perform the task in the home area outside the restroom area or in an initial position anywhere inside the area where infrastructure can be installed. Participants must inform the judges when they finish their setup or if the setup is not required.

2.3. Cleaning Demonstration

After the judges confirm that the preparations are finished, the judges will add the simulated urine described hereafter and scatter garbage. Afterwards, the demonstration will begin.

The participants will input the start command into the system that controls the mobile robot and infrastructure.

After the system operation starts, participants are not allowed to control the robot or to take any actions that will influence the operation of the system. Any team that manipulates the operation of the system will be withdrawn



from the task at that point.

However, participants can decide to retry the task as described hereafter if continuing the demonstration is deemed difficult due to system malfunction.

3. Details of Challenge

The challenge will have a maximum score of 100 points:

- Cleaning the simulated urine: 50 points
- Cleaning the garbage: 50 points

3.1. Cleaning the Simulated Urine

Judges disperse simulated urine (300 ml) around the restroom by spraying the simulated urine around the toilet bowl with the toilet seat open using a sprayer (peeing boy statue) (Fig. 2). The simulated urine is a fluorescent paint (UV ink) diluted with water.

Images will be taken to record the state of the restroom before spraying the simulated urine as well as before and after cleaning, and the removal rate of the simulated urine will be measured. The full 50 points will be given to participants with an 80% or higher removal rate. The simulated urine left in the restroom area after scoring will be cleaned by the venue staff.

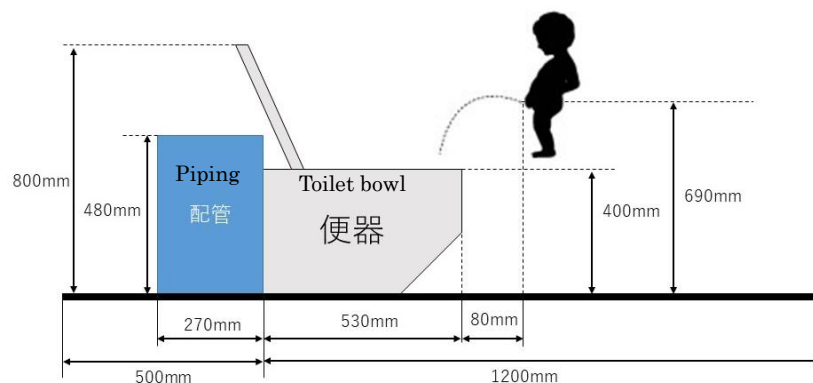


Fig. 2 Sprayer and toilet bowl position

3.2. Cleaning the Garbage

Judges will scatter a total of five pieces of garbage randomly composed of four scraps of toilet paper (maximum length of approx. 5 cm) and one toilet paper roll. Furthermore, the garbage will be scattered after the simulated urine is sprayed and may become slightly wet due to the simulated urine previously dispersed. The restroom will be deemed as clean by either throwing the garbage in the garbage can or storing the garbage inside the robot itself.

Participants are allowed to decide the shape of the garbage can and this garbage can be placed in the area for the mobile robot and in the infrastructure installation area during the renovation time or setting time. 10 points will be awarded for each piece of garbage that is cleaned. (Maximum of 50 points)

3.3. Retry

Participants can ask the judges to terminate the demonstration in order to retry the task if the system malfunctions and continuing the demonstration is deemed difficult. Participants can retry many times.

However, the clock will continue to run while the demonstration is stopped. Furthermore, the mobile robot and infrastructure will be returned to their initial state. The points awarded for cleaning the simulated urine will be a reference score. In other words, cleaning will be 0 points and multiple participants with the same score will be determined superior or inferior based on the removal rate. Participants will keep the points already earned for pieces of garbage that have been cleaned, the garbage still left to clean will be returned to its position before the demonstration was stopped, and then the task will resume.

4. Specifications and Restrictions

4.1. Standard Toilet Bowl

The standard toilet bowl and toilet seat installed at the venue are as follows:

- Toilet bowl: TOTO Pure Rest QR
- Toilet seat: Standard toilet seat for above

Furthermore, simulated urine will be sprayed while the toilet seat is up.

4.2. Original Toilet Bowl

Participants can use a toilet bowl that has unique geometry and functionality instead of the standard toilet bowl. However, the original toilet bowl must satisfy the following requirements:

- The toilet bowl has a pool of water.
- The toilet bowl can be used for both stool and urine.
- The toilet seat is down when sitting and the height of the toilet seat is approximately 400 mm from the floor.
- The toilet bowl accommodates men to pee while standing.
- The toilet must have a projected area of approximately W370 x D530 mm protruding from the floor.

4.3. Floor

The floor will be a black, vinyl chloride sheet.

4.4. Mobile Robot and Infrastructure Restrictions

4.4.1. Hardware Restrictions

- There are no restrictions for the number of mobile robots.
- Each mobile robot must occupy less than 1 m x 1 m of floor space and all of the mobile robots must fit into the home area.
- The initial position of mobile robots must fit in the Infrastructure

Installation Area if the mobile robots will be placed inside such area.

- The initial position of infrastructure must be within the Infrastructure Installation Area.
- Mobile robots and infrastructure may not have an external supply of water. However, a total of one liter of water may be carried inside the robot to use.
- The use of cleansers is prohibited.

4.4.2. Software Restrictions

- The robots and infrastructure must operate autonomously after the start of the task. However, participants may monitor the internal status remotely to know the state of their system.
- Mobile robots are prohibited from moving outside of the convenience store.
- The mobile robot must exit the restroom area or return to the Infrastructure Installation Area. Infrastructure must return to the Infrastructure Installation Area.

4.4.3. Energy Source Restrictions

- Participants should prepare an energy source to use for their robots.
- A power supply within AC100V/1500W is planned as the energy source for participants to use.
- Any energy source deemed to be dangerous or inappropriate for use will not be allowed.

4.4.4. Venue Restrictions

- Participants are prohibited from intentionally flooding, staining or damaging the convenience store or restroom area.
- Infrastructure must be removed immediately after the task ends to return the venue to its original state.
- A beam will be installed 2 m above the floor and below the ceiling in the toilet area. Lightweight measuring devices such as a camera will be mounted into the beam. This camera measures the simulated urine and there must not be any interference with its operation.
- The convenience store have no ceiling or walls.

4.4.5. Safety Restrictions

- Systems must have an emergency shutdown switch in case of an emergency. All of the movable parts included in the system must immediately stop operating if the emergency shutdown switch is pressed.
- The design must prevent the system from tipping over at all times, including during an emergency stop.
- Measures must be put in place to shield any area with a danger of entangling the arms or legs of people in the vicinity.
- Hot areas and sharp edges must not protrude.
- Energy sources utilizing fire or high temperatures are prohibited.
- Any laser used in the system must be class 1 or lower.
- Products and parts of robots must not eject anything.

5. Other

This rulebook is subject to change without notice.