



WRS Future Convenience Store Challenge  
Preliminary Competition 2018

“Display/Disposal” Task

Rulebook

2018/02/02

## Revision History

February 2, 2018

- A subject about an energy saving was added.

January 15, 2018

- First Draft

## 0. Definitions of 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 tasks of the robot. This equipment includes markings, IC tags, sensors, actuators and auxiliary tools to add equipment to products. Infrastructure made up of sensors and actuators can also be seen as stationary robots.
Manipulator	Robot arms, hands and other equipment that execute operations which can be equipped or installed on a mobile robot or as part of the infrastructure.
Product	Products found at a convenience store.
Customer	Person who visit the store to purchase products.
Container	Container used to hold and transport multiple products. A container may also be called a carton.
Product Display Area	Section of the convenience store with display cases or book shelves 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 customers are not permitted (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.

## 1. Overview

This challenge aims to develop technology to automate the display of products and collection of disposal items at a convenience store. Participants in this competitive task shall develop a robot that autonomously moves and performs these tasks as well as infrastructure to install inside of the convenience store. In this competitive challenge, participants will use the robots and infrastructure they develop to compete in the proficiency of operations via the systems developed to perform display and disposal demonstrations in a simulated convenience store.

The layout of the convenience store interior is provided in a separate document. In this challenge, participants use the backyard area, home station, aisles, display case A (case to display products that is initially empty) and display case B (case to collect disposal items that initially has a mixture of multiple products). Furthermore, display case A and B have a top shelf, a middle shelf and a bottom shelf.

The following tasks will be performed in the demonstration:

- Position the products stored in the container placed at the home station in the designated place on display case A.
- Straighten the products positioned in display case B while collecting disposal items, and then carry the disposal items to the home station.

In addition, the proposed system must contribute to energy saving in general or to the clerks' work reduction that leads to energy saving at the convenience store businesses.

## 2. Flow of the Competitive Task

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

- ① Renovation time
- ② Setting time
- ③ Display, collection, and disposal demonstration

Participants can distribute the time to each block however they would like. Participants should indicate their progression to the judges when transitioning to each block and when completing the competitive task.

### 2.1. Renovation time

Participants will be given a container with the products to display and a container for the disposal items.

Participants shall install infrastructure and replace the shelving. The work allowed during the renovation time is as follows:

- Installation of unique infrastructure inside the convenience store.
- Replacement of existing display cases and containers.
- Installation of unique infrastructure for products.

Participants shall indicate to the judges when they have finished their renovations or if renovations are not required while immediately returning disposal items to the judges.

### 2.2. Setting time

Judges will announce the disposal items and position those products randomly in display case B.

Next, participants set up the mobile robot to execute the task in any position inside of the field while putting the products in the container and placing the container in its initial position (attaching the container to the mobile robot, etc.).

Furthermore, participants will be allowed to control work to add labeling to disposal items for the system during this time (however, a person cannot teach the system the layout of the products placed in display case B).

Participants shall indicate to the judges when they have finished setup.

### 2.3. Display, collection, and disposal demonstration

Judges confirm the preparations have been made, and then initiate the start of the demonstration.

Participants operate the task start command for the system that controls the mobile robot or infrastructure. Furthermore, participants may decide the order in which to conduct product display and disposal item collection. (However, participants must tell the judges in which order they will start the demonstration before the competitive task starts.)

After the system operations start, no one is allowed to control the mobile robot or take any actions that will influence the operation of the system. Anyone who initially manipulates the operations of the system shall be withdrawn from the task at that point.

## 3. Details of Challenge

### 3.1. Layout of Products Inside the Container

Participants must store a total of 12 products inside of the container during the setting time: rice balls (2 types; total of 4 rice balls), drinks (2 types; total of 4 drinks) and lunch boxes (2 types; total of 4 lunch boxes). The products can be placed in the container in any orientation.

### 3.2. Initial Container Position and Product Transport

Participants can decide the initial container position (however, the container cannot be placed inside of the display case for the initial position).

The initial container position is set inside the home station. If the products can be transported to display case A and one or more of those products autonomously placed on the shelf, the product display will be deemed a success and double the points will be earned for subsequent product display tasks.

### 3.3. Product Display

Points are awarded for extracting products from the container and placing them in the designated position and orientation in display case A. (Total 25 points)

- Rice balls shall be placed on the top self. The same type of rice balls shall be placed vertically (front to back) and a different type of rice ball shall be placed next to it.
- Drinks shall be placed on the center shelf. The same type of drink shall be placed vertically (front to back) and a different type of drink shall be placed next to it.
- The lunch boxes shall be placed on the bottom shelf. The same type of lunch box shall be placed vertically (front to back) and a different type of lunch box shall be placed next to it.
- 2 points will be awarded for each product placed in the designated position. 1 point will be awarded for products placed on the shelf but not in the designated position.
- A bonus point (1 point) will be added if two or more of each product is placed in the designated position on all three shelves.

### 3.4. Collecting Disposal Items and Facing Them Up

The products will be eight sandwiches (2 types: 4 of each type) and four of those eight sandwiches shall be disposal items. Participants can determine the shelf to use from the three shelves in display case B, and then the judges will line up a mix of sandwiches. Disposal items shall be collected by checking the expiration date written on the backside of the sandwiches. Products shall be placed face up. Products near the expiration date shall be collected as disposal items. Furthermore, products left on the shelf shall face up (return the products to the designated position with the front side out). The same types of sandwiches shall be bundled and lined up at this time.

Points are earned by arranging products in their designated positions and collecting disposal items. (Total 25 points)

- 3 points is awarded for each disposal item stored in the container.
- 3 points are awarded for each remaining product facing up in the correct position.
- A bonus point (1 point) is awarded if four disposal items are taken from the shelf or if the four remaining products are facing up in the correct position.

### 3.5. Disposal Item Transport

Disposal item transport will be deemed a success if one or more of the disposal items can be brought back to the home station after the disposal item collection task is complete to double the points earned in the disposal task.

### 3.6. Retry

Participants can release an object if the task is terminated during object operation and return that object to the position before manipulation with the manipulator. Under other circumstances, participants return the object to the position and orientation indicated by the primary judge supervising the progress of the task up until that point. (The score also rolls back to the score at that time)





## 4. Specifications and Restrictions

### 4.1. Products for the Task

The four types of products for this task; rice balls, drinks, lunch boxes, and sandwiches. Each product will have two different flavors (approximately same dimensions and weight). Examples of each product are outlined below. The competition will prepare the products. Furthermore, some of these products may not be used for the competitive task on the day of the competitive challenge due to changes in the product line-up. An alternative product with similar product specifications shall be used in the event of a change. These changes will be announced on the official competition homepage.

#### 4.1.1. Rice Balls

- Product name: Red Salmon
- Outer dimensions: Approx. H75 x W80 x D35 mm
- Weight: Approx. 110 g

#### 4.1.2. Drinks

- Product name: Café Latte (240 ml)
- Outer dimensions: Approx. H108 x W76 x D76 mm
- Weight: Approx. 260 g

#### 4.1.3. Lunch Boxes

- Product name: Deep-fried Chicken Lunch Box
- Outer dimensions: Approx. H50 x W250 x D175 mm
- Weight: Approx. 535 g

#### 4.1.4. Sandwiches

- Product Name: Egg Sandwich
- Outer dimensions: Approx. H140 x W90 x D70 mm
- Weight: Approx. 105 g

#### 4.1.5. Adding Auxiliary Tools to Products

Participants can innovate the geometry and materials of the containers and packages of products as well as attach markings such as bar codes or IC

tags to more easily operate the manipulator. However, auxiliary tools that harm the presentation as a product, are unsanitary, interfere with storage or display, or cannot be used in the microwave are prohibited. Participants must set up auxiliary tools during the renovation time.

## 4.2. Container

### 4.2.1. Standard Container Specifications

- Sanko SN Container C#32S
- Outer dimensions: 716 x 460 x 128 mm
- Inner dimensions: 662 x 422 x 119 mm

### 4.2.2. Usage Restrictions for Unique Containers

Participants can create their own containers to use in place of the standard containers. However, the following requirements need to be satisfied:

- Products used for the display task must all fit inside the container.
- The containers must be able to stack.
- The size must be equivalent to the standard container (estimate: 850x600[mm])

## 4.3. Display Case

### 4.3.1. Standard Display Case Specifications

- Slit-type system fixture (gondola shelving)
- Outer dimensions: H1500 x D454 (Shelf 400) x W950 mm
- Three display shelves (D400 x W900); top, center, and bottom
- Each shelf is transparent and has a transparent front rail to prevent products from falling (H35 mm)
- Both sides of the display case has side mesh

### 4.3.2. Usage Restrictions for Unique Display Cases

Participants can create their own display cases to use as infrastructure in place of the standard display cases. However, the following requirements need to be satisfied:

- The outer dimensions must be within H2000 x D2000 x W2000 mm.
- Display cases must not protrude into the aisles.
- The display cases must have three or more shelves (D400 x W900) for the

display task and disposal task.

- Each shelf must be transparent and take measures to prevent products from falling.
- The products displayed on the shelves must be accessible to patrons.
- The display case cannot be secured to the ceiling, floor, or walls of the venue.

## 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 take up less than 1 m x 1 m of floor space and all of the mobile robots must fit into the home station.
- A mobile robot must have a size within one square meter in its initial position and during movement. Furthermore, the container will be seen as one part of the robot if the container is built into the robot. However, the robot may exceed this size temporarily while unloading the container, displaying products, or collecting disposal items.
- Infrastructure can be installed anywhere inside of the convenience store, but different restrictions apply according to the area of the store. Please see the documents provided separately for more information.

### 4.4.2. Software Restrictions

- The mobile robots and infrastructure must move autonomously after the start of the competitive task. However, participants may monitor the internal status remotely to learn the state of their system.
- Mobile robots are prohibited from moving outside of the convenience store.

### 4.4.3. Energy Source Restrictions

- Participants shall prepare an energy source to use for their mobile 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 permitted.

#### 4.4.4. Venue Restrictions

- Participants are prohibited from intentionally staining or damaging the convenience store.
- Infrastructure can be removed immediately after the competitive task ends to return the venue to its original state.
- The convenience store has 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 operation 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. Frequently Asked Questions

Q. Are deductions taken if a product is damaged?

A. Deductions are not taken. However, this may impact the evaluations by judges.

Q. Can the order of the display and disposal tasks be switched?

A. The order to perform the tasks is not designated. Participants need to inform the judges of which task they will attempt in advance because judges and officials have the final say.

Q. Can we use multiple containers?

A. Yes, you can use multiple containers.

Q. What is the stacking strength of the containers?

A. Participants can use their own container as long as it does not exceed the standard container size (estimate: 850 x 600[mm])

Q. Is there a blueprint of the product shelves?

A. Details about each shelf are provided in 4.3.1. Please ask the appropriate manufacturer.

Q. Are there indicators such as borders around the home area?

A. The competition plans to use different color flooring for each area, but there are no clear barriers between these areas.

Q. Are there any restrictions about the number of people for the renovations and setup?

A. There are no restrictions in particular about the number of people for the renovations and setup.

Q. Can the renovations and setup be conducted at the same time?

A. Yes.

Q. Can products be repackaged in original containers?

A. Yes, products can be repackaged. However, make sure original packaging

is sanitary and maintains the same quality.

Q. Will a network be available to use for monitoring the status of the robot?

A. Participants should configure this network. However, each group is responsible for this network because limitations such as the wireless LAN bandwidth are not currently taken into account. Furthermore, underlay of cables that inhibits movement in the aisles will not be permitted.

Q. Is the size of the robot (1m x 1m) a restriction for the initial position?

A. Transformations are allowed as long as the robot can return to its original state at the end of the task.

[Acceptable Example] The robot exceeds the 1 m x 1 m size restriction when the manipulator is extended, but does not exceed this size in its initial posture.

[Unacceptable Example] The robot moves along its route while dropping items, but these items cannot be picked up afterwards.

Q. Will there be water droplets on the products?

A. Products are store up to the competitive task in accordance with the storage instructions designated on the products. Participants shall appropriately handle water droplets and other issues with products during the setting time.

Q. Does the size restriction apply to robots with containers built-in?

A. Yes, the size restrictions apply.

## 6. Other

This rulebook is subject to change without notice.



# WRS Future Convenience Store Challenge Preliminary Competition 2018

“Customer Service” Task

Rulebook

2018 /02/02



## Revision History

February 2, 2018

- A subject about an energy saving was added.

January 15, 2018

- First Draft

## 0. Definitions of 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 tasks of the robot. This equipment includes markings, IC tags, sensors, actuators and auxiliary tools to add equipment to products. Infrastructure made up of sensors and actuators can also be seen as stationary robots.
Manipulator	Robot arms, hands and other equipment that execute operations which can be equipped or installed on a mobile robot or as part of the infrastructure.
Product	Products found at a convenience store.
Customer	Person who visit the store to purchase products.
Container	Container used to hold and transport multiple products. A container may also be called a carton.
Product Display Area	Section of the convenience store with display cases or book shelves 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 customers are not permitted (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.

## 1. Overview

This challenge aims to develop technology to automate customer service, which is part of the job for employees at a convenience store. The people participating in this competitive task shall develop a robot that autonomously moves and performs customer service operations as well as infrastructure to install inside of the simulated convenience store. In this competitive challenge, participants will use the robots and infrastructure they develop to compete in the innovativeness, viability and feasibility of the systems developed to perform customer service demonstrations in a simulated convenience store space.

The layout of the convenience store interior is made up of a product display area, cashier area, restroom area, aisles, and backyard area as shown in a document provided separately.

Participants can set the challenge related to customer service freely to perform a system demonstration within the time limit for the competitive task.

In addition, the proposed system must contribute to energy saving in general or to the clerks' work reduction that leads to energy saving at the convenience store businesses.

## 2. Flow of the Competitive Task

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

- (1) Renovation time
- (2) Setting time
- (3) Presentations
- (4) Customer service demonstrations

Participants can distribute the time to each block however they would like. Participants should indicate their progression to the judges when transitioning to each block and when completing the competitive task.

### 2.1. Renovation time

Participants add or replace furnishings such as the infrastructure and shelving. The work allowed during the renovation time is as follows:

- Installation of unique infrastructure inside the convenience store.
- Replacement of existing furnishings such as display cases and the cashier counter.

Participants shall indicate to the judges when they have finished their renovations or if renovations are not required.

### 2.2. Setting time

Participants next set up their robot and necessary products. Participants arrange the robot and products in any initial position inside the simulated convenience store. Participants shall indicate to the judges when they have finished their setup or if the robot setup is not required.

### 2.3. Presentations

Participants explain the purpose and an overview of the system they have

developed. The presentation may also be conducted at the same time as the demonstration below. Participants should indicate to the judges when the presentation is finished or when conducting the presentation at the same time as the demonstration.

## 2.4. Customer Service Demonstration

Judges confirm the preparations have been made, and then initiate the start of the demonstration.

Participants operate the task start command for the system.

After the system operations start, participants are not allowed to control the robot or take any actions that will influence the operation of the system. Participants who initially manipulate the operations of the system shall 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

### 3.1. Customer Service Challenge

Participants can set the challenge related to customer service freely to perform a system demonstration within the time limit for the competitive task. For example, the competition expects a demonstration similar to those below.

- Heating purchases (lunch boxes, etc.) or bagging products
- Receiving orders and retrieving products for products ordered through a clerk such as hot snacks and cigarettes
- New services based on recognizing gender, age and products customers are hesitant to purchase
- Recommendation of products
- Prevention of shoplifting
- Customer service for customers with special needs such as elderly, foreign nationals, or people who use a wheelchair
- Assistance and other services

These are only a few examples of customer services. Not all of these services need to be implemented. However, including the interaction between people (staff/customers), the competition expects proposal and demonstrations that foresee a future of new services. The competition also expects participants to generate appeal by illustrating the specific use prescribed to their system in their demonstration via role-playing and other means. Participants shall apply with a description of their customer service in advance. The judging panel evaluates those customer services from the perspectives outlined below.

Judges score customer services by awarding points based on the following criteria:

- Presentation
- Viability
- Feasibility

Furthermore, customers to provide customer service shall be prepared by participants.

### 3.2. Retry

Participants can ask the judges to terminate the demonstration to retry the task if the system malfunctions and continuing the demonstration is deemed difficult during the customer service task.

However, the clock will continue to run while the demonstration is stopped. The participants can decide in what state to resume the competitive task.

## 4. Specifications and Restrictions

### 4.1. Simulated Convenience Store

The convenience store will be an 8 m × 7 m space made up of a product display area, cashier area, restroom area, aisles, and a backyard area. The cashier area will have a counter. The product display area will include display cases and book shelves. Detailed information about the layout, counter and display cases inside the convenience store will be provided in a separate document.

Participants are not allowed to change the layout inside the convenient store such as rearranging the display cases in the aisles during the renovations.

### 4.2. Product

Participants shall prepare the products to use in the demonstration.

### 4.3. Mobile Robot and Infrastructure Restrictions

#### 4.3.1. Hardware Restrictions

- There are no restrictions for the number of mobile robots.
- Each mobile robot must take up less than 1 m x 1 m of floor space and all of the mobile robots must fit into the home station.
- Infrastructure can be installed anywhere inside of the convenience store, but different restrictions apply according to the area of the store. Please see the documents provided separately for more information.

#### 4.3.2. Software Restrictions

- The robots and infrastructure must move autonomously after the start of the competitive task. However, participants may monitor the internal status remotely to learn the state of their system.
- Mobile robots are prohibited from moving outside of the convenience store.



#### 4.3.3. Energy Source Restrictions

- Participants shall 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 permitted.

#### 4.3.4. Venue Restrictions

- Participants are prohibited from intentionally staining or damaging the convenience store.
- Infrastructure can be removed immediately after the competitive task ends to return the venue to its original state.
- The convenience store has no ceiling or walls.

#### 4.3.5. 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 operation 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

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WRS Future Convenience Store Challenge  
Preliminary Competition 2018

“Toilet Cleaning” Task

Rulebook

2018/02/02

## Revision History

February 2, 2018

- A subject about an energy saving was added.

January 15, 2018

- First Draft

## 0. Definitions of Terminology

Term	Definition
Mobile Robot	A robot that can move autonomously.
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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 customers are not permitted (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.

## 1. Overview

This challenge aims to develop technology to automate restroom cleaning, which is one daily task of employees at a convenience store. Participants in this competitive task shall develop a robot that autonomously moves and performs cleaning operations as well as infrastructure (robot) to perform cleaning operations that can be installed inside of the restroom area. In this competitive challenge, participants will use the robots and infrastructure they develop to compete in the proficiency of operations via the systems developed to perform cleaning demonstrations of the toilet and floor in a simulated restroom space.

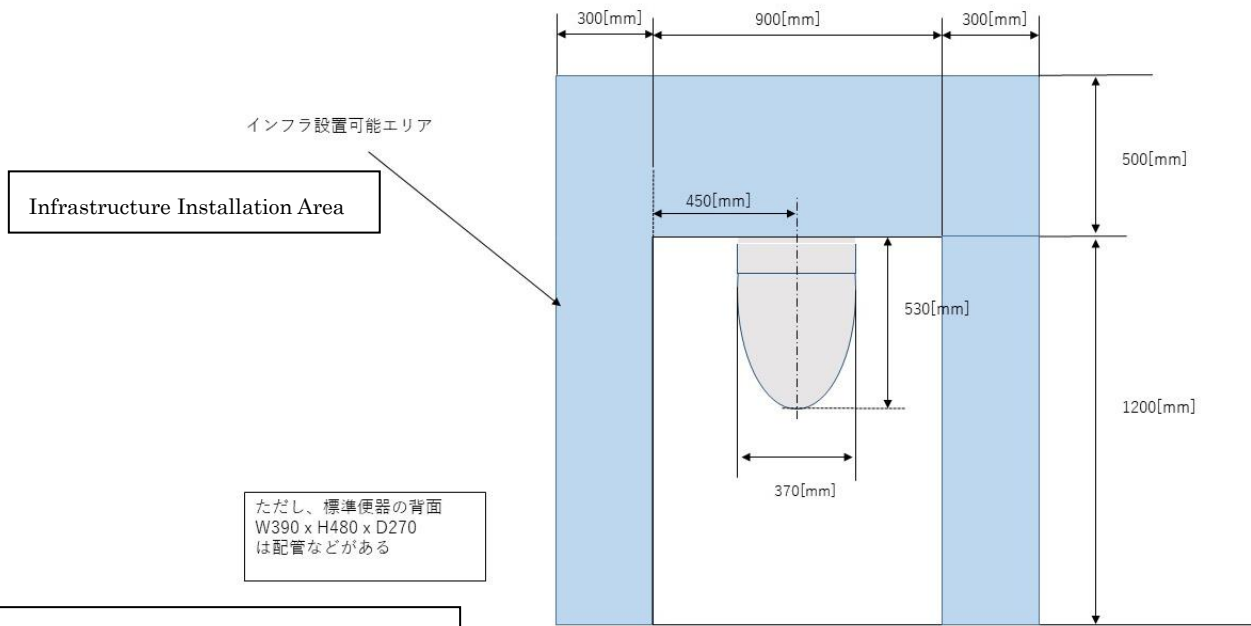
The restroom area is made up of a toilet, floor and an area to install infrastructure in the layout shown in Figure 1.

The demonstration will consist of the following two types of tasks:

- Cleaning simulated urine on the toilet (rim {top of toilet bowl} and toilet seat {when up}) and floor around the toilet. The inside of the toilet bowl is outside the scope of this task.
- Cleaning garbage scattered on the floor (roll and scraps of toilet paper).

Furthermore, a comprehensive explanation about the cleaning will be described later.

In addition, the proposed system must contribute to energy saving in general or to the clerks' work reduction that leads to energy saving at the convenience store businesses.



However, the backside of the standard toilet bowl (W390 x H480 x D270) has piping and other fixtures.

Figure 1: Layout of Restroom Area

## 2. Flow of the Competitive Task

The time limit for this competitive task will be 20 minutes. The competitive task will proceed in 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 block however they would like. Participants should indicate their progression to the judges when transitioning to each block and when completing the competitive task.

### 2.1. Renovation time

Participants install their infrastructure inside of the area where infrastructure can be installed. Participants shall indicate to the judges when they have finished their renovations or if renovations are not required.

### 2.2. Setting time

Participants next set up their mobile robot. Participants shall place the mobile robot to perform the task in the home station outside the restroom area or in an initial position anywhere inside the area where infrastructure can be installed. Participants shall indicate to the judges when they have finished their setup or if mobile robot setup is not required.

### 2.3. Cleaning Demonstration

Judges confirm the preparations have been made, add the simulated urine described hereafter and scatter garbage, and then initiate the start of the demonstration.

Participants operate the task start command for the system that controls the mobile robot and infrastructure.

After the system operations start, participants are not allowed to control the robot or take any actions that will influence the operation of the system. Participants who initially manipulate the operations of the system shall 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).

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 is given to participants with an 80% or higher removal rate. The simulated urine left in the restroom area after scoring will be cleaned by venue staff.

#### 3.2. Cleaning the Garbage

Judges 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 damp due to the simulated urine that is 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 may be placed in the area for the mobile robot and infrastructure installation 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 to retry the task if the system malfunctions and continuing the demonstration is deemed difficult during the cleaning task.

However, the clock will continue to run while the demonstration is stopped. Furthermore, the mobile robot and infrastructure shall be returned to its



initial state. The points awarded for cleaning the simulated urine shall be a reference score (in other words, cleaning will be 0 points and multiple participants with the same score shall be determined superior or inferior based on the removal rate). Participants shall 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 standing water and flushes.
- 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 stand and pee.
- 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 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 take up less than 1 m x 1 m of floor space and all of the mobile robots must fit into the home station.
- The initial position of mobile robots must fit in the area to install

infrastructure if the mobile robots will be placed inside the area to install infrastructure.

- The initial position of infrastructure must be within the area to install infrastructure.
- Mobile robots and infrastructure may not have an external supply of water. However, a total of one liter of water may be built-in to use.
- The use of cleansers is prohibited.

#### 4.4.2. Software Restrictions

- The robots and infrastructure must move autonomously after the start of the competitive task. However, participants may monitor the internal status remotely to learn 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 within the area to install infrastructure. Infrastructure must return to the area to install infrastructure.

#### 4.4.3. Energy Source Restrictions

- Participants shall 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 permitted.

#### 4.4.4. Venue Restrictions

- Participants are prohibited from intentionally flooding, staining or damaging the convenience store or restroom area.
- Infrastructure can be removed immediately after the competitive task ends to return the venue to its original state.
- The convenience store has 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 operation 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.

# Restrictions for Infrastructure Installation Area



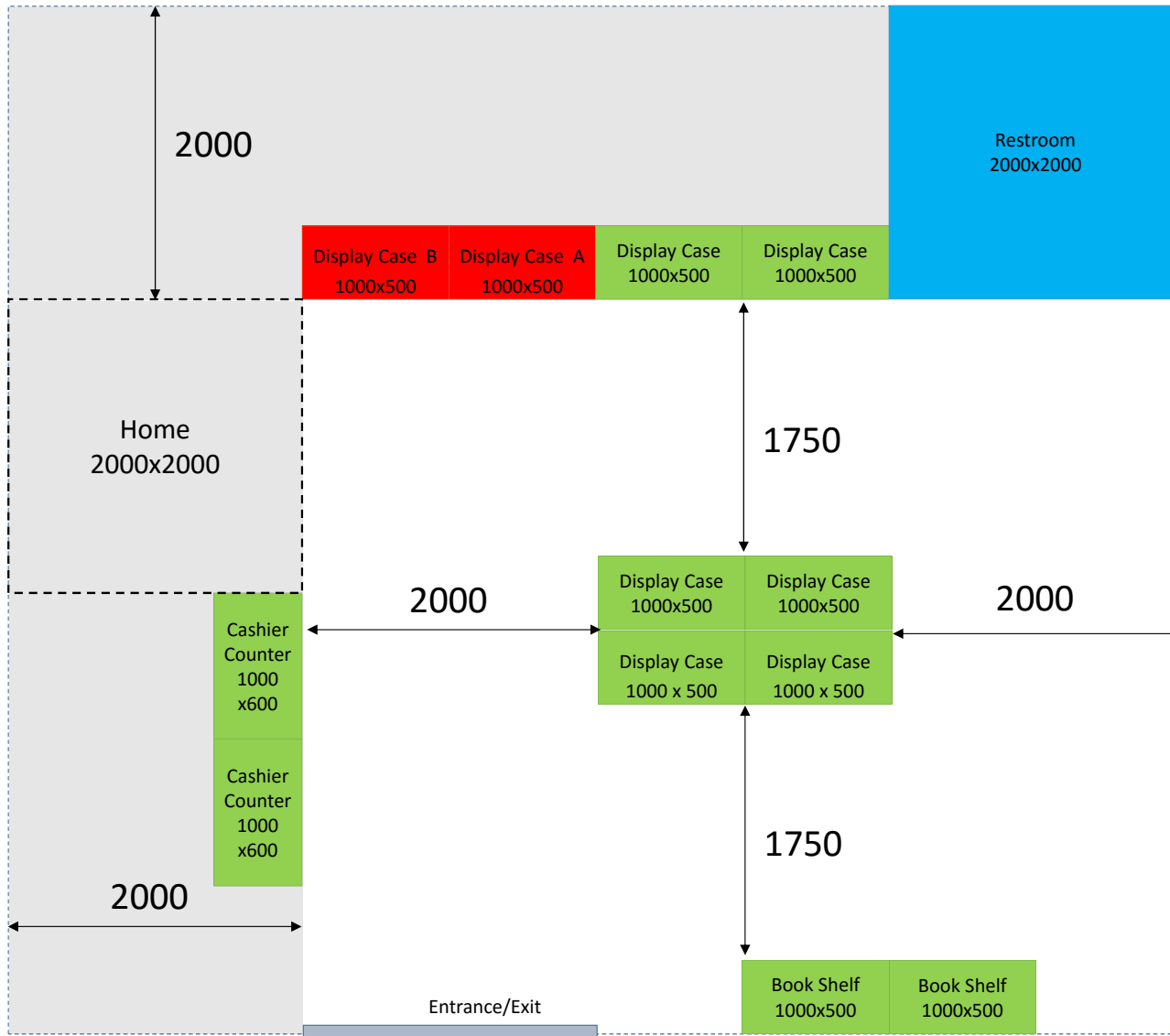
Equipment that can be used:

	Product Display Area	Cashier Area	Restroom Area	Aisle Area	Backyard Area	Product	Container
Actuators	○	○	○	×	○	×	○
Sensors	○	○	○	○	○	×	○
Markings and IC tags	○	○	○	○	○	○	○
Wire connections for communication and power	○	○	○	○	○	×	△

## Supplementary Information

- Infrastructure installed in an area other than the aisles must not protrude into the pathway.
- However, infrastructure may protrude into the aisles temporarily when in operation.
- Infrastructure installed in the aisle must not inhibit the movement of patrons.
- Wired connections to containers must automatically connect and release.
- Make sure to secure cameras with a tripod or other device if installing cameras as a sensor.

Simulated Convenience Store Layout



Red: Primarily used for the display and disposal challenge  
 Green: Primarily used for the customer service challenge  
 Blue: Used for the cleaning challenge

White: Aisles  
 Gray: Backyard

Simulated Convenience Store Dimensions 8000 x 7000 mm