

Automated Toilet Cleaning System

Host Organization: Tata Consultancy Services

Preamble to the Problem:

Cleanliness and hygiene of toilets are generally considered as cultural indicators for an individual as well as the society. No one wants to clean a toilet and one would like to outsource it at the very first opportunity. It's not only the dirt, water, stains and odour that are deterring, but the difficulty in cleaning surfaces of fixtures of various complicated shapes, and this is what poses a significant challenge. While the floor and walls are flat, the commode and wash basin have shapes difficult to clean. Moreover there are multiple parts of varying sizes and materials including toilet seat, rim, sides, bowl etc which require different methods for cleaning and require different cleansing agents.

The problem gets much more aggravated for public toilets. Multiple toilet units are integrated there and in general they are extremely dirty due to heavy traffic and limited cleaning support. Moreover, people with different toilet habits makes the situation worse.

Therefore, it is highly beneficial to explore the use of robots for toilet cleaning. This will be a great technological contribution to Swachh Bharat Mission. However it is a challenging task to design such a robot due to the complexity of the tasks involved. For the same reason, we are opening it as an innovation challenge to the brightest technology talents of India to unleash their creativity and skills to solve this problem of national importance.

Problem statement :

Build and demonstrate a fully automated mobile robot that can clean a toilet. The tasks involved are:

- a) Clean the toilet rim, seat, sides and bowl
- b) Pickup trash (such as toilet paper) on the floor
- c) Clean the floor

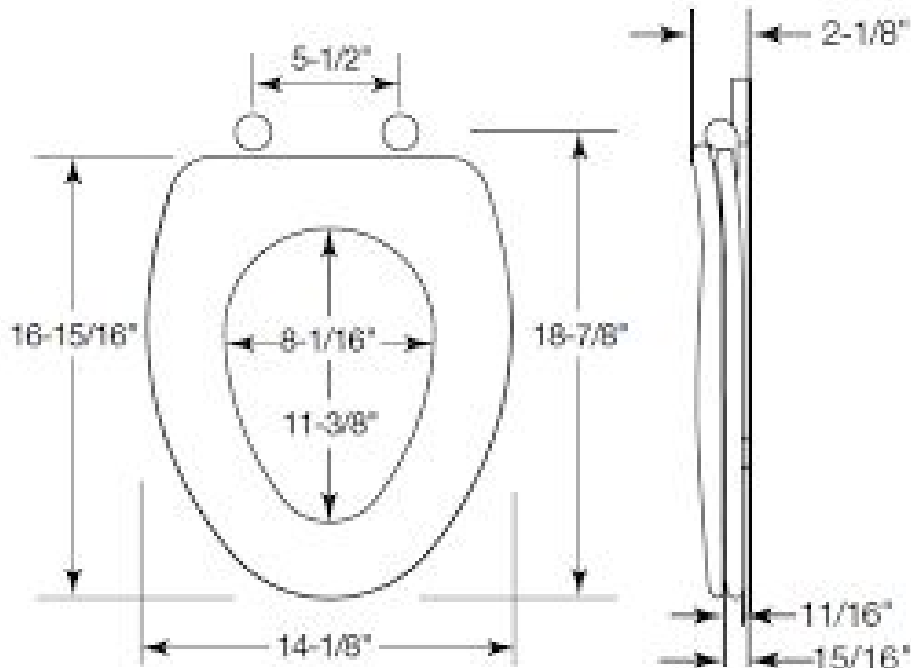
Robot constraints: The robot should be compact, user friendly, cost effective and should consume minimum resources.

The size of the bot is restricted by the size of the room. The bot should have cordless operation(should not be connected to a plug point)

Challenge Setup:

A mockup toilet will be set up with some trash distributed on the floor.

The toilet is of a typical western commode style with a height of about 40-45 cm from the ground. The dimensions of the rim will be standard as shown in the figure.



The arena dimensions will be about 8 ft x 8 ft and will have a toilet, a tap and a bucket. The entrance will have a width of 2 ft. An optional water connection will be provided. The pipe will have a diameter of 0.5 inch. A team may also choose to carry a water storage system on the robot.

The stains on the floor and commode will be made using a water based acrylic having a minimum diameter of 50 mm(not necessarily circular) and will be darker than the background in colour to enable easy identification. Points will be awarded on the basis of precision of identification of stains and area of stains removed. The trash to be removed will be balls of toilet paper of minimum diameter 50 mm.

Since this robot is meant to replace humans, it should be extremely cost effective. Teams will have to present a budget description in the presentation and points will be awarded based on cost-effectiveness of the solutions.

Operation scenario : Human opens the toilet door , brings the robot to the door and presses a button to start cleaning. Once the cleaning process is complete the robots comes back to the door and alerts the human operator.

Judging criteria:

1. There is a time limit of 15 minutes for this task.
2. For cleaning the commode seat, sides, rims and bowl the total points awarded is 200. Correspondingly, points will be deducted for incomplete cleaning. For eg: If cleaning 1 stain is worth 20 points, if you clean half of it, you get 10 points. A stain is considered cleaned if the colour intensity is reduced by a significant amount.
3. For cleaning the floor of the toilet and picking up trash, the total points awarded is 150+50. Again, points will be deducted for incomplete cleaning.
4. Every team will also need to do a presentation on their design and approach. Judges will award a maximum of 100 points depending on the versatility and innovation present in the design.
5. Once the bot is setup from the starting point, it will have to perform both the tasks autonomously.
6. A team will be allowed one intervention. After an intervention, the bot can be placed anywhere in the arena. If however, the team wishes to change the position of the bot(including placing the bot on top of the commode), a penalty of 50% of whatever points achieved from that point onwards will be awarded.
7. If a team manages to complete both the tasks, the amount of water used will be measured. 50 bonus points will be awarded to the most efficient team and correspondingly, the points for the other teams will be awarded.
8. The decision of the judges will be final.