Robot Powered Water Conservation Device Challenge

Due Date:

Thursday, April 28, 2022

Saving water must be a way of life for people of all ages in Southern California. Climate change and frequent droughts are straining water resources across the state and Southern California. Even when the current drought ends, it's only a matter of time when the next one will arrive. And climate change means that we will face more extreme weather in the future, including longer, hotter dry periods.

Metropolitan Water District's job is to ensure Southern California always has the water it needs despite these challenges. In addition to protecting the supplies we import from Northern California and from the Colorado River, we have been developing local water resources, investing in our water system and helping everyone in the region conserve water.

Southern Californians have done a great job – the region uses less water today than it did in 1990, despite the population growing over that time period. But due to increasing challenges, we must find more ways to cut water use – every action we take makes a difference. Some of the ways Metropolitan works with the region to conserve is to provide rebates on devices that help households and businesses reduce their water use. Residents within our service area can receive money back for purchasing water efficient devices such as irrigation controllers that help us more effectively water our landscapes and leak detection monitors that help consumers easily and quickly identify and fix leaks. More rebates and devices are listed on the Bewaterwise webpage, www.bewaterwise.com.

Challenge Requirements

For this Challenge you will be asked to design a new kind of water saving device, one that makes saving water even easier, because it is powered by a robot. People are relying on technology to make their lives more efficient. Today we rely on gadgets or devices to help us do our chores, some people have robot vacuums that do the vacuuming for them. We use new technologies in our kitchens with appliances that make cooking times faster and healthier. This Challenge wants you to focus on ways to use technology to help people save water. Be creative, come up with ways a robot can help people save water!

- Your device can help people save water indoors or outdoors at home, school or businesses.
- Each device will be a scaled down version or model of the device
- Each device must be drawn in a CAD program like Onshape
- The device will have to be 3D printed
    - Can use Occidental College to print your device
    - Can print at your school if you have printer
- You will create a presentation that explains your device. Include a video of your robot moving with the device
- Might be easiest to make a micro team to get the work finished
    - Divide up the different parts of this Challenge.
        - Research water conservation and devices
            - Decide which area you can make an impact
            - Device brainstorm - decide what to make
        - Robot Assembly and Programing
            - Assemble robot and learn how to program it
            - Add device once it comes back from printing
            - Program robot to do what video team wants to show
        - Video team to get best video of robot in action
        - Presentation creation team
        - Onshape drawing team
        - Device Printing team
            - Get Occidental contact from Julie
            - Get drawing sent to Occidental College for printing
            - Keep in contact with Occidental staff to keep track of device
            - Get completed device to Robot team
- We will accept one response to this Challenge per school.
- Submit work detailed in the Work Submission section to Julie at jamiller@mwdh2o.com

Document It ~ Extra Credit

Use video or photos to document your work. Get creative. Examples include a time-lapse video of you conducting the challenge, a selfie with the finished product, or a self-narrated video about your work. Metropolitan may post selected submissions on our social media accounts to promote Solar Cup and the work students are doing. Be sure to avoid profanity and inappropriate or copyrighted images or music. For a required media release, and upload instructions contact Julie Miller Kalbacher at jamiller@mwdh2o.com. You also may post your videos and photos on your own social media account, or your school's account. Be sure to tag Metropolitan at @mwdh2o and use the hashtag #SolarCup. Students that turn in a signed media release and upload their finished product to their school folder can earn up to 100 extra points. The more creative your idea, the more points you will earn.

Scoring/Deliverables

- Teams will **earn up to 650 points** for this Challenge.
    - Teams will be awarded points in following areas:
        - **Up to 200 points** for originality/creativity of the device
        - **Up to 250 point can be earned in Presentation**
            - **Up to 100 points ~** Narrative explaining your device
            - **Up to 50 points** ~ Including CAD drawing with dimensions
            - **Up to100 points** ~ Narrative explaining your research in field to water conservation. Also include in this narrative the water wasting habit your device will solve.
        - **Up to 200 points for Presentation values**
            - Creativity/Originality of Presentation
            - Visuals used in Presentation
            - Factual Accuracy
            - Video of robot moving with device
    - Be sure to include your school name on the files that you send to Julie.
    - If the files are too large to email, **ask Julie for access. She will send you a link to the shared OneDrive Folder for your team.**
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Water Conservation

As we mentioned on page one of this Challenge, water conservation needs to be a way of life for everyone in Southern California. We must find ways to save more water. Do some research on ways people use water. Can you find ways that people waste water and may not even know they are wasting water?

You want your device to help people save water at home, at school, at work. The device can help people save water inside or outside. Are there ways people are wasting water that can be helped if they had a robot powered device? Can a robot and device accomplish a task while using less water? Identify that task or that water conservation issue and design the solution.

Teams can reach out to their sponsoring water agency to get water conservation information that is specific to their area. Contact Julie at Metropolitan for a contact person at your sponsoring agency. Teams can also reach out to Julie to get regional water conservation information. Review websites like www.bewaterwise.com for conservation information. Many water agencies also use social media to help get general water conservation information to people. Reviewing social media sites may help your brainstorming.

3D Printing

Most CAD software, like Onshape, can be used to create the drawing of your device. If you have access to a 3D printer at your school, check to see what printing requirements you need to follow. Don't forget to factor in to your Onshape drawings how the device you create will attach onto your robot. See more about that in the next section, Robot Attachment/Fixture 3D Printing Tips.

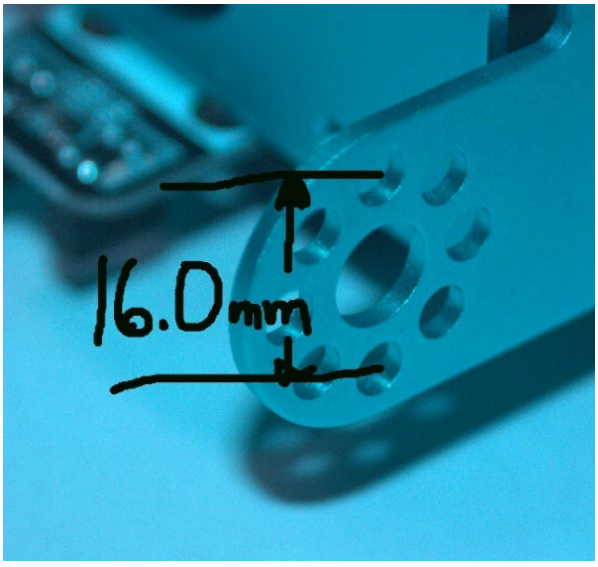
To use Occidental College as your print source, your CAD drawing must be a **.stl** file for it to be printed. College students at Occidental will review all submissions for printing and if anything needs to be adjusted on your team's drawing, they will contact you. Contact Julie at jamiller@mwdh2o.com and she will put you in contact with Chuck Oravec at Occidental College. Chuck will also be available to provide feedback on devices you are printing at your school, if needed.

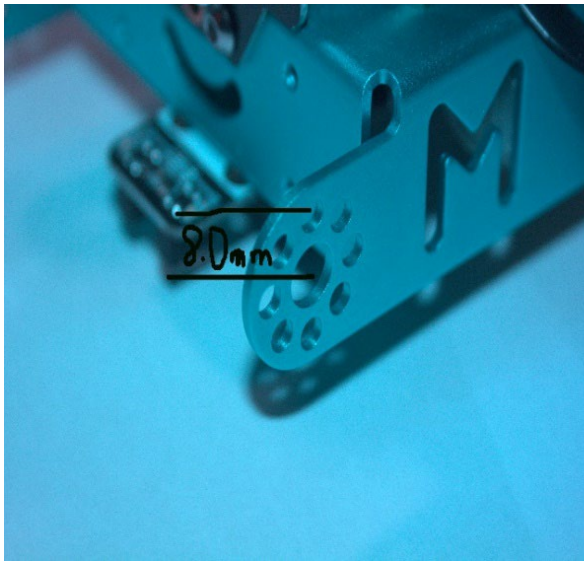
Don't wait too long to get in contact with Julie about 3D printing requests. Each request takes time to print and if you use Occidental College, they need time to box up and mail back to your school. You may need to have adjustments made once you get the device back from printing, because it may not fit. You want to make sure you have time to get your device printed, time to make the video and put together your team's presentation.

Robot Attachment/Fixture 3D Printing Tips

In the pictures shown below there are some dimensions which might be helpful when designing your fixtures used to attach the device to the mBot robot. These are the dimensions Chuck used when printing the parts shown below on the Occidental College printer, which is a Flashforge Adventurer 3. If you print your parts on a different printer, you might want to try making a few practice pieces to make sure they fit onto your robot the way you think they should.

1. This is a photo of the size of the holes on the mBot fixtures. Below are two pictures of the arms on the front of the robot where your model might attach a fixture of some sort:



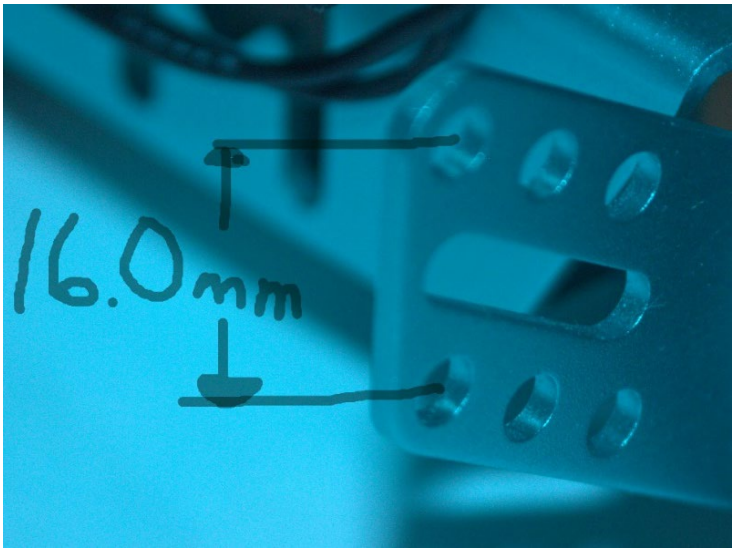


   a. Anything which must go through the smaller holes should be 2.0 mm in diameter.

   b. Anything which must go through the larger hole should be 8.0 mm in diameter.

   c. As shown in the picture on the left, the spacing between the small holes is 16.0 mm and in the right picture you can see that the distance between the center of the large hole and the center of one of the smaller holes is 8.0 mm. The smaller holes are all symmetrical around the larger one.

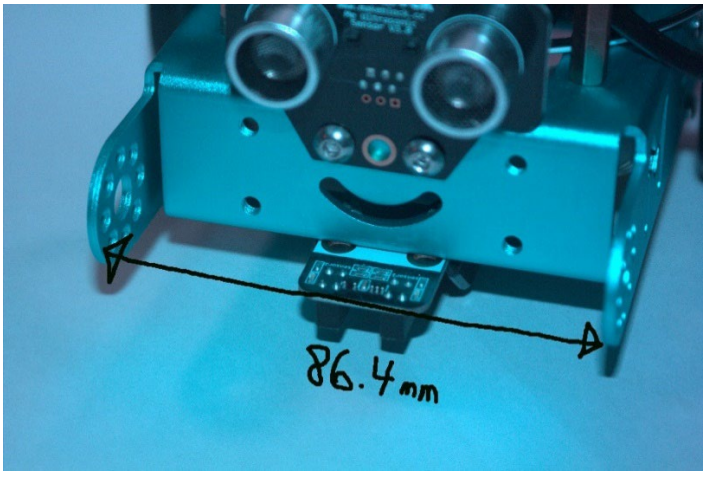
2. Below is a picture of the fixtures which come out of the back of the robot:



   a. Anything which must go through the smaller holes should be 2.0 mm in diameter.

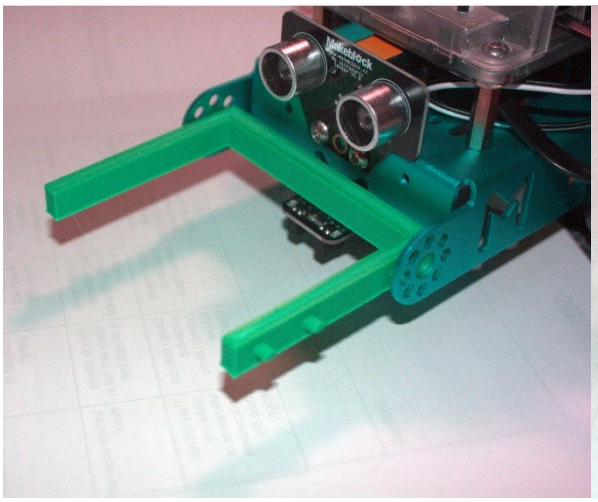
   b. As shown in the picture, the spacing between the centers of the small holes is 16mm.

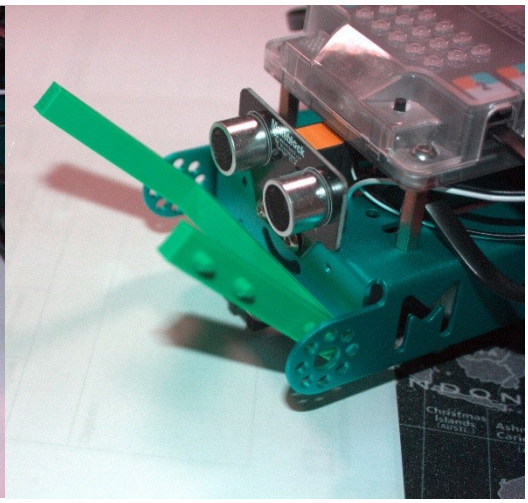
3. The distance between the left and right brackets is 86.4 mm as shown in the picture below:



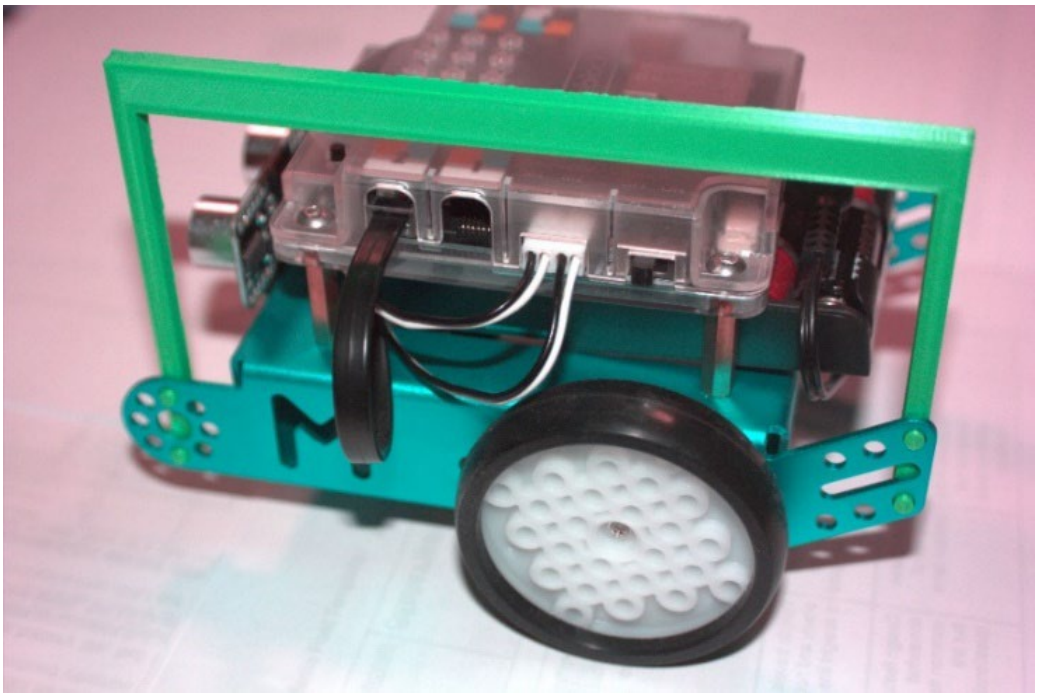
4. Using the dimensions above, Chuck made a fixture which attaches to the front bracket of the robot (see picture below). This fixture can obviously be rotated, be made longer, or maybe have a basket or a shovel or something on the end. If you don't want to try something as ambitious as putting a hinge on your fixture,

you might just use stop motion in your video editing to raise, lower, or rotate this fixture.

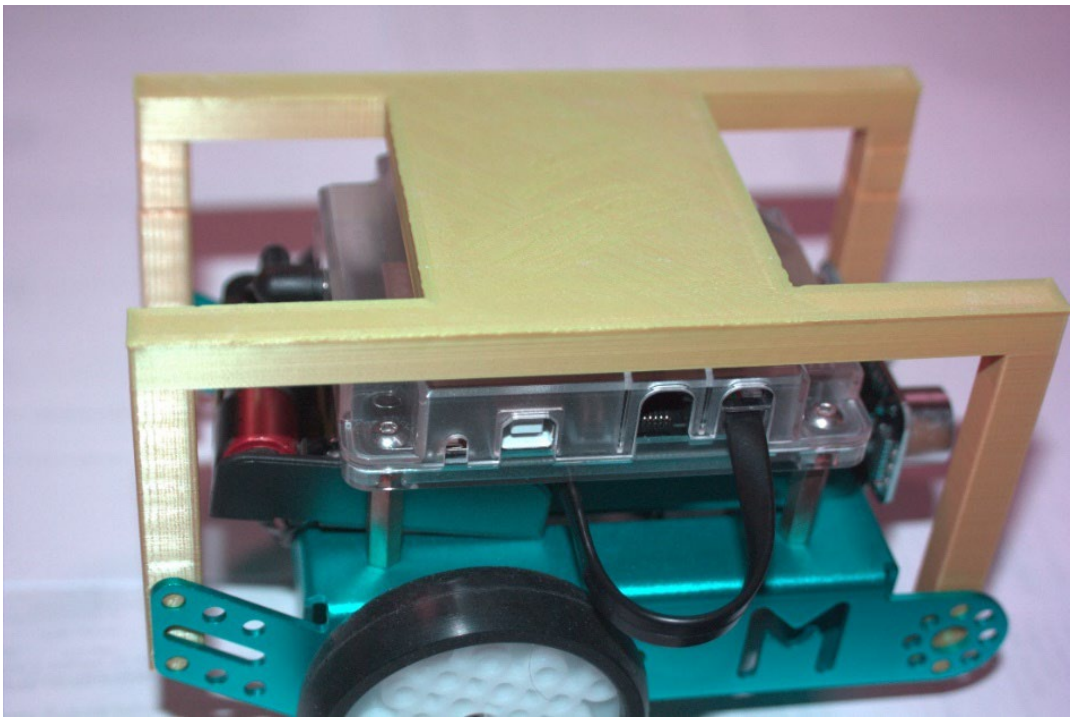




5. Below is a picture of a fixture which fits along the left side of the robot.
    a. In the piece shown below, the center-to-center distance between the small holes in the front and the small holes in the back are 150.0 mm
    b. The holes which connect to the front and rear of the robot are offset from one another along the vertical axis by about 1.4 mm.



6. Here is a picture of a platform which fits nicely along the top of the robot and attaches to arms on the front and the back.



If you have any questions, please send an email to Julie at jamiller@mwdh2o.com