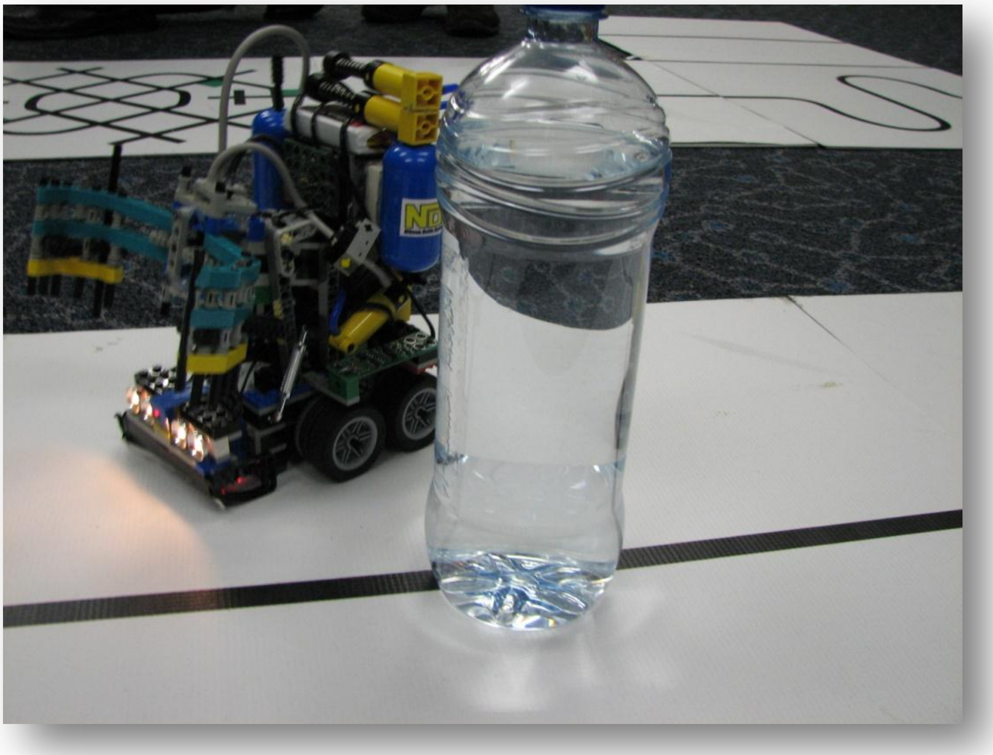
WATER TOWER

WATER TOWER - OBSTACLE DETECTION

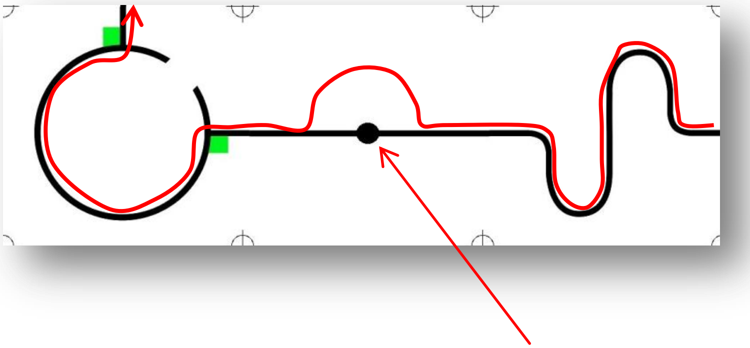
The Water Tower obstacle is made up of a 1.25 litre Pet bottle filled with water. Labels are removed.



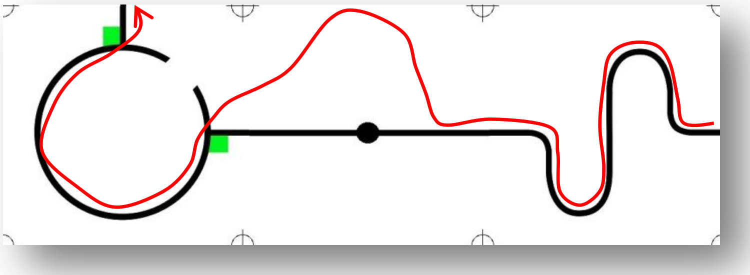
The problem involves the line following robot detecting the presence of the Water Bottle and then navigating around it. You are not allowed to move the bottle intentionally and this is usually determined if a robot appears to make no effort to stop pushing and therefore moving the bottle. If the bottle is moved off its spot then it is deemed to have moved the bottle intentionally and you will be required to restart your robot from the beginning of the course.

In addition, you need to design your robot so that as it navigates around the bottle it stays on the Water Tower tile. No 'wing' tiles will be placed on the edges of the Water Bottle tile to support the outside wheels of a wide turning robot. Also, you need to program your robot to regain the line on the Water Tower tile, not the following tile.

WATER TOWER - OBSTACLE DETECTION (CONT..)



The above robot track, in red, has successfully navigated around the Water Bottle and regained the line before the next tile.



The above robot has navigated around the Water Bottle, however, due to the closeness to the edge of the tile when rounding the Water Bottle it is obvious that the robots outer wheels would have dropped off the side of the tile. Tiles may be mounted on backing boards that could be 19mm thick. Your robot needs to take this into account as no wing tiles are allowed. Also, the robot has not regained the line on the Water Bottle tile, but has joined the line on the next intersection tile. The robot can continue under the rules but will NOT get the 10 points for the Water Tower tile and as such, has not completed the course. For a run to b timed less than the 2 minute maximum, this robot will need to restart and complete the Water Tower before the clock is stopped.

WATER TOWER – METHODS OF DETECTION

In this lesson, you will learn how to detect the Water Tower Obstacle and navigate around it so that the robot can continue to follow the line.

Methods of detecting the bottle are many and varied.

- Ultrasonics
- Touch Sensors, and
- Vision Sensing

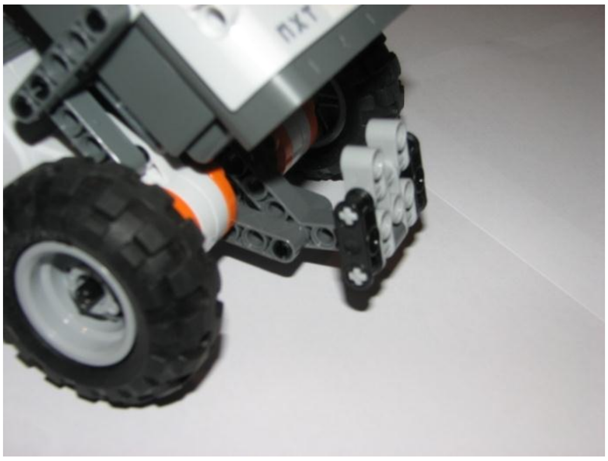
We will look at a solution using the Touch Sensor. Ultrasonics work reasonably well using the NXT Ultrasonic sensor, however, as the obstacle is a clear water filled cylindrical bottle, the Ultrasonic sensor can have unreliable results as the sound waves bounce off the bottle at an angle rather than directly back to the sensor. Vision Sensing (video cameras) is very new to NXT robots and is also very expensive but is allowed under the rules.

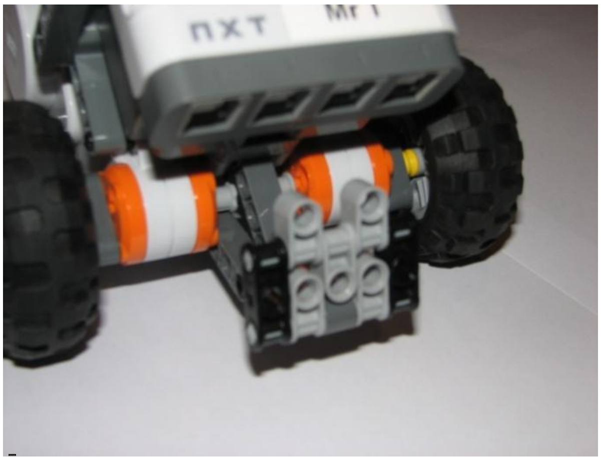
TOUCH SENSOR DETECTION OF THE WATER TOWER

This is one of the simplest methods of detecting the Water Tower and as this whole Premier Rescue challenge is very difficult, it is sensible to keep each challenge as simple as possible.

The Premier Rescue robot needs to be designed so that it has a Touch Sensor mounted onto the front of the robot so that it does not interfere with the line following sensors OR the sensors you intend to use to find the victim. You must also keep within the 270cm maximum diameter of the Premier Rescue robot rules. In this example, we will be simply adding the standard touch sensor from the NXT Education Kit to the front of the TriBot so that it extends over and in front of the line following sensors.

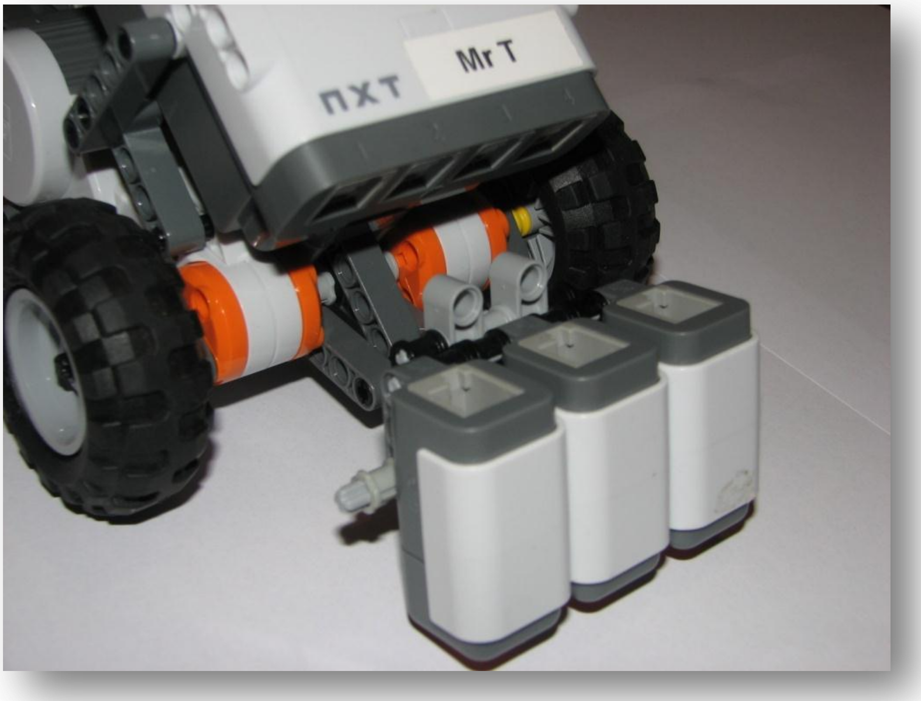
Below is a standard Tribot modified so that is can accept more than one sensor on the front sensor mount.



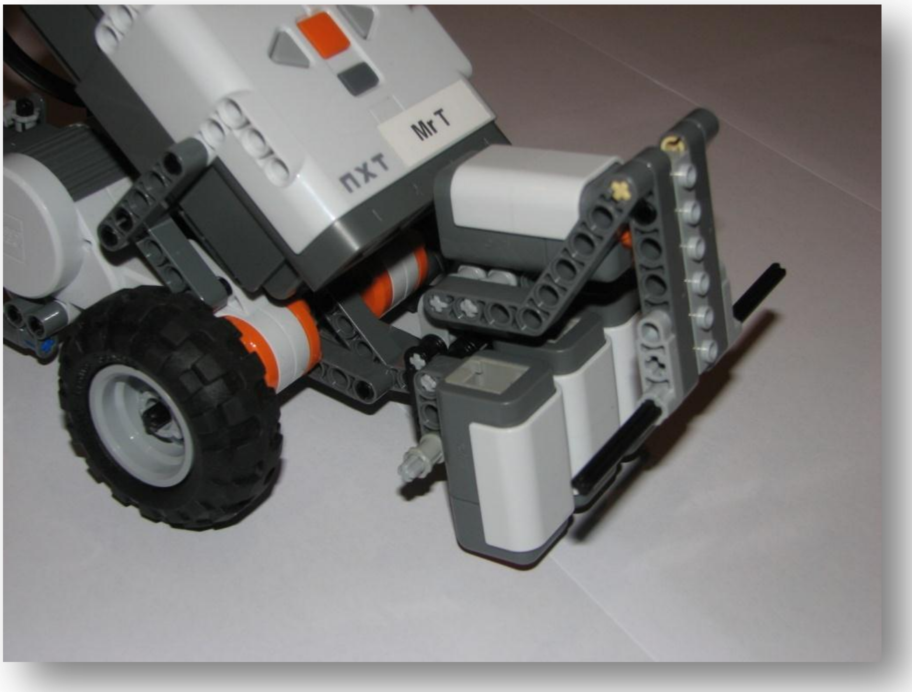


WATER TOWER – METHODS OF DETECTION (CONT..)

Here you can see a triple light sensor line follower rig mounted onto the bottom or standard sensor supports.



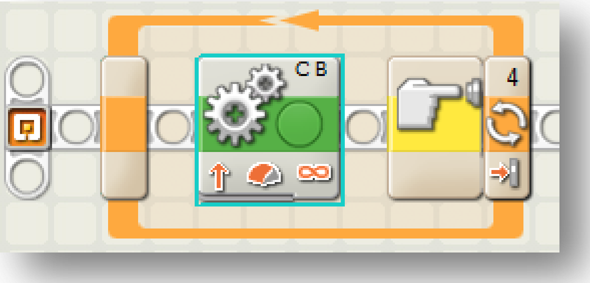
And now the Touch Sensor rig is in place mounted onto the new upper sensor supports.



WATER TOWER – METHODS OF DETECTION (CONT..)

For this example we will create a simple program that will drive our robot forward until the touch sensor detects the water bottle. This would normally be the line following program but in an effort to develop a modular approach to problem solving, we will solve the water bottle on its own.

1. Place a Loop Block on the Sequence Bar and then place a Move Block inside it.
2. Set the Control property of the Loop Block to Sensor and then select the Touch Sensor form the Sensor group.



3. Make sure you select the port you have connected the Touch Sensor to, in this example port 4 is used.
4. Set the Action property to Pressed.

Download and run the program. Set the robot on the line facing the Water Bottle. The robot should move forward and stop when the Touch Sensor hits the Water Bottle.

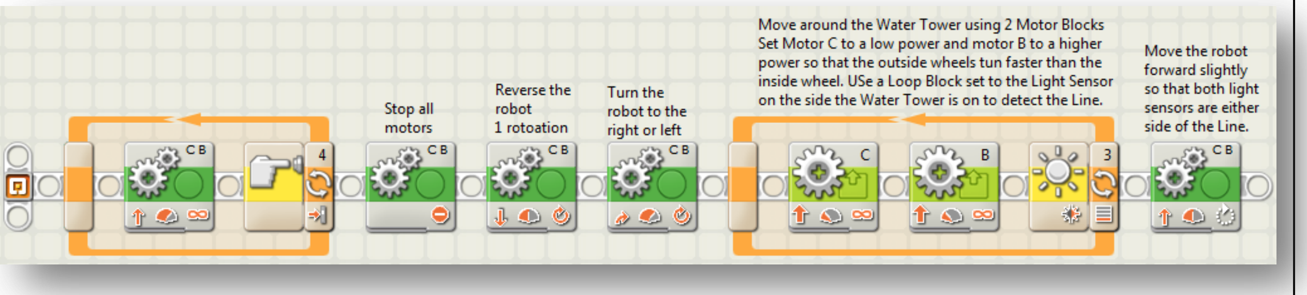
CHECK POINT

One thing you may have noticed or even foreseen was that the robot didn't actually stop moving forward straight away. The Mindstorms Move Block does not brake to a stop after the Loop Block reacts to the Touch Sensor condition being met, but coasts to a halt. What we need to ensure that we do not knock the Water Tower over is stop the robot immediately. To do this we need to stop all motors.

WATER TOWER – METHODS OF DETECTION (CONT..)

Once you have detected the Water Tower you need to create a program that will navigate around it as discussed at the beginning of this section. There are a number of methods you could use to successfully navigate around the Water Bottle including using another touch sensor on the side of your robot that is used to sense when the robot touches the Water Bottle as it skirts around it moving away and then back again until it has rounded the Water Tower. This is an excellent way to avoid skirting to far away from the bottle and risking going off the tile, however, it involves using another sensor port on the NXT and we have precious few to work with as it is. If you can devise a way to use a touch sensor on the side and all the other challenges that are required of the Premier Rescue then this may be the solution for you.

For this guide though we are going to keep it simple and use dead reckoning to simply drive around the Water Bottle in a set path that should see the robot miss the Water Tower and not fall off the edge of the tile.



Stop all motors

Reverse the robot 1 rotoation

Turn the robot to the right or left

Move around the Water Tower using 2 Motor Blocks Set Motor C to a low power and motor B to a higher power so that the outside wheels tun faster than the inside wheel. USe a Loop Block set to the Light Sensor on the side the Water Tower is on to detect the Line.

Move the robot forward slightly so that both light sensors are either side of the Line.

The above program is only a guide and you will need to experiment and adjust the property settings to get your robot to reliably navigate around the Water Tower.

An interesting point with the second Loop Block is that when using Motor Blocks instead of Move Block, the moment the Light Sensor on port 3 detects the line the robot stops immediately. Obviously Move and Motor Blocks behave differently, so be aware of this when programming your robot.

END OF SECTION

With a little tinkering you should be able to program your robot to detect the Water Tower with a touch sensor and then navigate around it finally regaining the line and start following it again.

We do need to be able to make our main program do many things at the same time in order to successfully complete a Premier Rescue course but that will come later. Bit off small chucks of a problem solving them in small manageable bits and you will begin to become a very good programmer capable of solving complex problems easily.