# Lab 5: Searching for Objects

## Demo 1: Object Identification (10 points)

The TA will check whether your robot can correctly identify a **Blue Styrofoam block** from another obstacle block. In this lab, the **Blue Styrofoam block** used has a dimension of 10cm-10cm-10cm as shown in **Figure 1A** below. Block B will be used later for the final project.

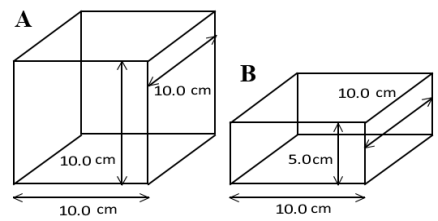


**Figure 1: Styrofoam blocks: A is used for Lab 5, B is used for the competition**

When any object (i.e. **Blue Styrofoam block**, a **wooden block**, etc.) is brought close to your sensor(s), the LCD must display "**Object Detected**". The next line in the LCD display should read "**Block**" for a **Blue Styrofoam block** or "**Not Block**" otherwise. You should demonstrate **5 successive trials** to the TA using a **Blue Styrofoam block** and one of the **wooden blocks** in the lab. You can decide the distance between the tested block and the sensor. Note that this objective identification process should not take more than 10 seconds per trial and can occur anywhere (depending on your implementation). The following points are awarded in this demo:

- **1.0 point** each time your robot detects a block (i.e. LCD reads **"Object Detected"**)
- **1.0 point** each time your robot identifies a block (i.e. LCD reads **"Block"** for a **Blue Styrofoam block** or **"Not Block"** for a **wooden block**)

## Demo 2: Searching for Objects (20 points)

Your robot will be placed in the **starting corner** of the **4-by-4 tile floor** as shown in the example setup of **Figure 2** (check **FAQ 1**). For a successful completion, your robot should correctly identify objects encountered and search until a **Blue Styrofoam block** is found and delivered to the **final destination**. You have a ***maximum of 5 minutes*** to perform this demo (check **FAQ 2**). After a pressing a button, your robot must be fully autonomous in performing the following operations:

- *Localization*: your robot starts by localizing to the (0,0) coordinates of the grid as in Lab 4.
- *Search*: your robot searches for objects using its sensors. When it encounters an object, it should **beep once** for a **Blue Styrofoam block** and **twice** otherwise. If the object is not a **Blue Styrofoam block**, it should move away it (e.g. a **wooden block**) and continue searching.
- *Capture*: if a **Blue Styrofoam block** is detected, your robot should move it to the upper-right hand corner, **beep thrice** when the move is completed, and then stop.

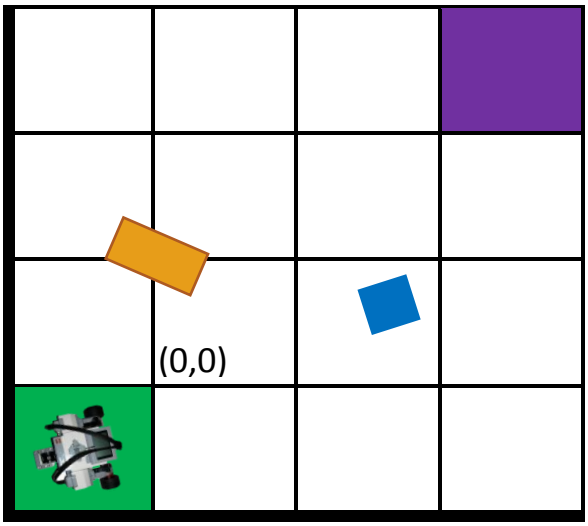


**Figure 2. Example Setup for Demo 2**

The following points are awarded in this demo (check **FAQ 3/4**).

- **5.0 points** for successful localization
- **2.5 points** for detecting any block
- **2.5 points** for identifying any block
- **5.0 points** for avoiding an obstacle
- **2.5 points** for capturing a Styrofoam block
- **2.5 points** for moving a Styrofoam block to the destination.

## Frequently Asked Questions (FAQ)

**1.** Will the setup of **Demo 2** look exactly like in **Figure 2**?

No, your robot could be placed in **ANY ORIENTATION** and **POSITION** along the 45° line in the **starting tile** (similar to Lab 4). Also, the **Blue Styrofoam block** and the **wooden block** could be placed in **ANY ORIENTATION** and **POSITION** on the **4-by-4 tile floor**. There is no guarantee there is a clear path from **Blue Styrofoam block** to the **final destination**. Since there are only two blocks, you should either place your US sensor to avoid the **wooden block** or figure out where it is beforehand.

**2.** What happens if my robot does not complete **Demo 2** in ***5 minutes*** or falls off the floor?

Once the timer reaches ***5 minutes*** or your robot falls off the floor, the demo will be stopped and you will be awarded points for performing the finished operations. For instance, if your robot finished localization, detected and identified a block, you will only be awarded **10/20** in **Demo 2**.

**3.** What are some clarifications **Demo 2**'s specification?

- Touching the **wooden block** voids the **5.0 points** for obstacle avoidance.
- Your localization only determines the heading in the right orientation with your US sensor. Your robot will start at the **starting tile** with a randomized heading.
- The **2.5 points** for capturing a Styrofoam block grade is awarded once your robot captures the block or starts moving it for a few centimeters.
- You are not allowed to push the **wooden block**, since it is not the **target block**.
- The minimum spacing between walls and blocks, blocks and blocks, blocks and the **starting tile** or **final destination,** are all half a square tile.
- There will be two blocks on the **4-by-4 tile floor**: one **wooden block** and one **Blue Styrofoam block**. You must find the **Blue Styrofoam block** and avoid the **wooden block**.
- **Blue Styrofoam blocks** are cubic (10x10x10cm). **Wooden blocks** are on their flat side (10cm high). The position of your robot's sensors should not be a factor.
- There will only be two walls fixed in the **starting corner** of the **4-by-4 tile floor**.
- Your robot should not fall off the **4-by-4 tile floor**, but the **Blue Styrofoam block** may fall off when it is pushed to the **final destination**.
- The block configuration will be randomized for every group.

**4.** What is the worst possible case for **Demo 2**?

If your robot fails the "*hardest test*", where the **Blue Styrofoam block** is **(1)** placed behind the **wooden block** or **(2)** the robot cannot avoid the **wooden block** after collecting the **Blue Styrofoam block**, the maximum mark you can attain in **Demo 2** would be **15/20**. In other words, you need to retrieve the **Blue Styrofoam block** when it is either behind or in front of a **wooden block** on your way to the drop-off zone for full marks in **Demo 2** (**20/20**).

However, if you cannot accomplish scenarios **(1)** and **(2)** described above, you can try an "easier scenario" **(3)** where the **wooden block** and the **Blue Styrofoam block** are further apart from each other similar to **Figure 2**. Hence in scenario **(3)**, you can achieve **15/20** for **Demo 2** if all other requirements are met: localization, identification of either **wooden block** or **Blue Styrofoam block** and dropping off the **Blue Styrofoam block** at the **final destination**.

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