**ENGG1100 Introduction to Engineering Design**

**Faculty of Engineering**

**The Chinese University of Hong Kong**

**Project Description**

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| **Introduction** The project challenge is to design and build a robot that can self-navigate on a testing board, detect and pick up an object, and drop the object at a designated position. Further details (e.g., size of zones, height of the cans, and the assessment scheme) will be provided later. Each group is required to demonstrate its robot in Week 14. There are totally three tasks to be completed, which will be described in sequence. For convenience of describing the project challenge tasks, the following acronyms will be used: |
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| **START** | The start zone is where the robot starts its journey. It is on a boundary of the testing board. |
| **CAN(1,2,3)** | A can refers to an empty 330ml cylindrical soft drink container.The 3 containers are named as **CAN1**, **CAN2** and **CAN3,** respectively. |
| **INP(1,2,3)** | **INP1**, **INP2** and **INP3** are the initial positions of **CAN1**, **CAN2** and **CAN3**, respectively. |
| **DST\_ZONE** | The destination zone is where the robot releases the **CAN**(s). It is also on a boundary of the testing board. |
| **DST** | **DST** refers to the center position of an edge of the **DST\_ZONE**. That particular edge touches the boundary of the testing board. |

**Basic Task**Figure 1(a) shows the basic task. Your robot should begin at the **START** zone on the testing board, move to **INP1**, pick up **CAN1**, and deliver **CAN1** to the destination **DST\_ZONE**. Each group can determine its own positions for **START**, **INP1** and **DST** under the following constraints:* **START**, **INP1** and **DST** never lie on a straight line.
* **START** and **DST** must be on the boundaries of the testing board and at different positions.
* The angle between line **START-INP1** and line **INP1-DST** should be at least 30 degree.

Each group should prepare its own testing board.

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| **INP1****CAN1****DST****START** |  |
| (a) The testing board with the robot and **CAN1** | (b) magnetic strips under the testing board |

**Figure 1: The testing board for the basic task****A piece of iron****Magnet strips****Figure 2: A CAN with magnetic strips placing on the side and a piece of iron placing on the top**To be specific, the basic task may be divided into the following steps:1. The robot should begin at **START** and find **CAN1**. To achieve this, the robot is guided by the magnetic strips underneath the testing board as shown in Figure 1(b). The robot should be able to detect **CAN1** and stop near **INP1**. To allow the robot to detect **CAN1**, you may modify **CAN1** by placing magnetic strips and other materials on the surface of **CAN1**; e.g., see Figure 2.
2. The robot should pick up **CAN1** at **INP1** by its electromagnet.
3. The robot should then move to **DST** and stop there to release **CAN1** in **DST\_ZONE**, which is outside the testing board. However, the wheels of the robot should always stay inside the testing board.

A demo video for the basic task can be found at http://youtu.be/dy\_u7lxMkTY.The whole process should be completed automatically without your intervention.**Challenge Task 1**Challenge task 1 is similar to the basic task, except that the robot should carry and deliver two cans, rather than one. Let us call the first and second cans **CAN1** and **CAN2**, respectively; and the corresponding initial positions **INP1** and **INP2**, respectively. The positions of **START**, **INP1, INP2** and **DST** can be freely designed under the following constraints:* **START**, **INP1, INP2** and **DST** never lie on a straight line.
* **START** and **DST** must be on the boundaries of the testing board and at different positions.
* The positions of **INP1** and **INP2** must be different.

An example for challenge task 1 is depicted in Figure 3. The task may be divided into the following steps:1. The robot should begin at **START** to find and pick up **CAN1** at **INP1**, in the same way as the basic task.
2. While holding CAN1, the robot should move again to find and pick up **CAN2** at **INP2**. At this stage the robot should hold both **CAN1** and **CAN2**.
3. The robot should move to **DST** and stop there to release **CAN1** and **CAN2** into **DST\_ZONE**, which is outside the testing board. The wheels of the robot should always stay inside the testing board.

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| (a) | (b) |

**Figure 3:** **Examples of the testing board in challenge task 1****Challenge Task 2**You can choose either one of the following two challenge tasks.**Challenge Task 2.A**Challenge task 2.A is an upgraded version of challenge task 1 – the robot should carry and deliver three cans. The rules are the same as those in challenge task 1. An extra constraint is added to the testing board constraints mentioned in challenge task 1:* The path must intersect itself one and only one time.

Some examples of the testing board for challenge task 2.A are shown in Figure 4.

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| (a) | (b) |
|  |  |
| (c) | (d) |

**Figure 4: Examples of the testing board in challenge task 2.A****Challenge Task 2.B**Challenge task 2.B is the same as the basic task, except that the can is replaced by a different, arguably “difficult-to-pick-up”, object; for example, a sphere, a cone, a square bi-pyramid, or a snub cube, as shown in Figure 5.

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|  |  |  |  |
| 1. Sphere
 | 1. Cone
 | 1. Square bi-pyramid
 | 1. Snub cube
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**Figure 5: Examples of objects to be picked up in challenge task 2.B**You are required to prepare **two** different objects on your own. Again, you are allowed to place magnetic strips and pieces of iron on the surfaces of the objects. For each object, your robot performs the same steps as in the basic task (with the can replaced by that object). In addition, before starting the robot to pick up an object in challenge task 2.B, you are allowed to modify the robot to deal with that particular object. The assessment would be based on how difficult it is to pick up your selected objects and whether the robot can successfully pick them up. That is, more challenging objects your robot can handle, the higher the score you would expect. |

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