

Project n. 1

A number of objects (e.g., mega-blocks) are stored without any specific order on a stand (initial stand) located within the workspace of a robotic manipulator. The manipulator is an anthropomorphic arm, with a spherical wrist and a three-fingered gripper as end-effector. The objects can belong to different classes but have a known geometry (coded in the STL files). The objective of the project is to use the manipulator to pick the objects in sequence and to position them on a different stand according to a specified order (final stand). A calibrated 3D sensor is used to locate the different objects and to detect their mutual position in the initial stand.

The project is organised as a sequence of assignments of increasing complexity. The minimum requirement to pass the exam is that at least assignments 1 and 2 are completed. Each assignment is associated with some performance indicators that are used in the grading of the project.

Assignment n. 1

There is only one object in the initial stand, which is positioned with its base “naturally” in contact with the ground. The object can be of any of the classes specified by the project. Each class has an assigned position on the final stand, which is marked by a coloured shape representing the silhouette of the object.

KPI 1-1 time to detect the position of the object

KPI 1-2 time to move the object between its initial and its final positions, counting from the instant in which both of them have been identified.

Assignment n. 2

There are multiple objects on the initial stand, one for each class. There is no specific order in the initial configuration, except that the base of the object is “naturally” in contact with the ground. Each object has to be picked up and stored in the position prescribed for its class and marked by the object’s silhouette.

KPI 2-1: Total time to move all the objects from their initial to their final positions.

Assignment n. 3

There are multiple objects on the initial stand, and there can be more than one object for each class. The objects are positioned randomly on the stand but would not stand or lean on each other. An object could be lying on one of its lateral sides or on its top. Each object has to be stored in the position prescribed by its class. Objects of the same class have to be stacked up to form a tower.

KPI 3-1: Total time to move all the objects from their initial to their final positions.

Assignment n. 4

The objects on the initial stand are those needed to create a composite object with a known design (e.g., a castle). The objects are positioned randomly on the stand. An object could be lying on one of its lateral sides or on its top. The objects could also stand or lean on each other. The manipulator has to pick them up in sequence and create the desired composite object on the final stand.

Delivery rules

The project is developed in groups. The typical group size consists of three-four members. We can also accept groups with a smaller number of members. The group is supposed to work in perfect cooperation and the workload is required to be fairly distributed. The specific contribution of each member will be exposed during the project discussion.

The delivery phase is as follows:

1. The project will have to be tested in the laboratory with the Teaching Assistant at most 5 least five days before the exam date. During the tests, small videos can be shot and used for the presentation.
2. Each group will have to deliver the package containing the full code (with doxygen documentation and a readme for use) plus a 5-6 pages report describing
 - a. the technique used for perception
 - b. the technique used for robot motion
 - c. the technique used for high-level planning
 - d. A table with the KPI measured on Gazebo
3. The delivery deadline is three days before the exam presentation
4. On the day of the exam, the students will give a 20 minutes presentation highlighting the contribution of each member. A discussion will follow in which all members are supposed to answer questions on the entire project (regardless of her/his specific assignment within the group).
5. If allowed by the time, the group could also be asked to perform a small demo session. Otherwise, we will rely on the clip shot before the exam.