Tips and Tricks to improve your Ball Balancing Platform Design

[*Last Updated on:* ***25th November 2020, 22:30 Hrs***]

This document contains guidance to improve the design made by your teams in **Task 1C** i.e Design Ball Balancing Platform.

Expected design philosophy

In all the themes of e-Yantra's Robotics Competition (eYRC), we have always designed the tasks considering a practical viewpoint and feasibility. Hence it is expected from the participants to desig their models such that they work in real and simulated world.

Guidance for your design

The following points **should** be **noted and implemented** by teams in Task 3.

1. Make sure that two objects do NOT overlap with each other

- As shown in Figure 1, it is **NOT** allowed to position objects such that they are into each other.
- Notice that if two objects are into each other, the **boundary** (represented by the thin black solid line) will **not be visible**.
- In task 3, all the objects which are directly attached to the base plate, **should have all ticks fo local respondable masks**. Refer task 3 document for further details.

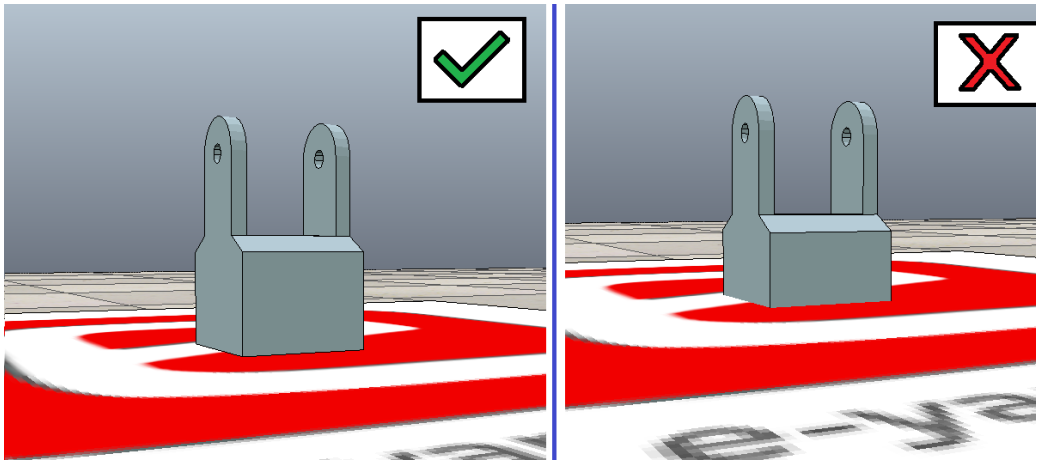

Figure 1: Overlapping of objects is **NOT** allowed.

2. Make sure there is NO gap between objects

- Objects should **not be left** hanging in the air as shown in Figure 2.
- The design should look **aesthetically correct**.

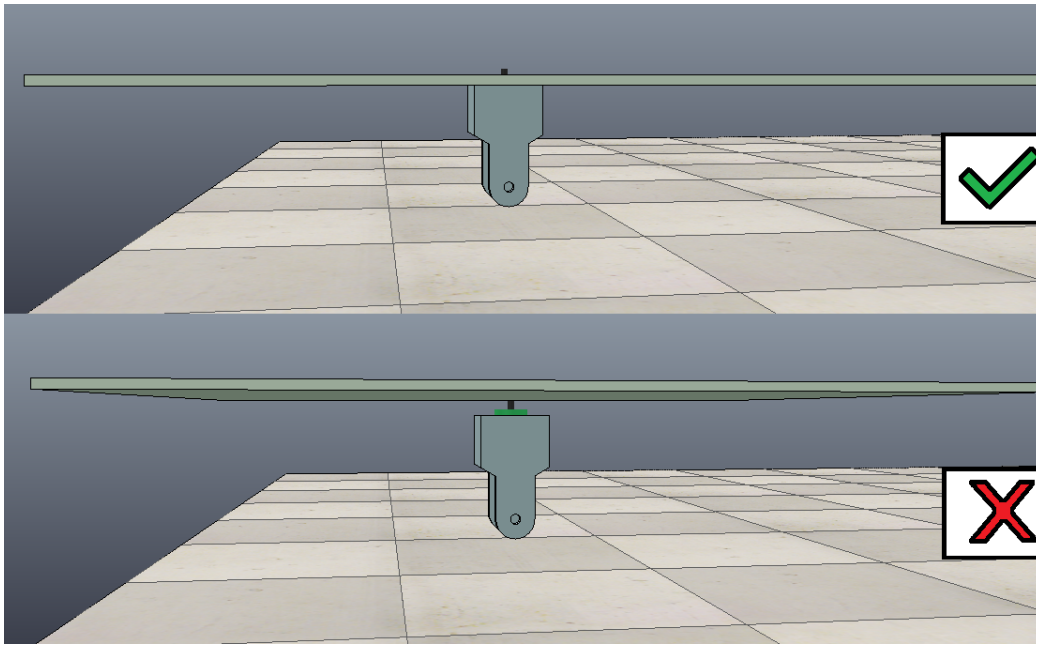

Figure 2: Extra gap between objects is **NOT** allowed.

- CoppeliaSim offers smallest **translation step size of 0.001** to position objects.
- Use this feature to position objects **accurately**.
- Click on  to **reposition** the selected object.
- Change the **translation step size to 0.001** as shown in Figure 3.

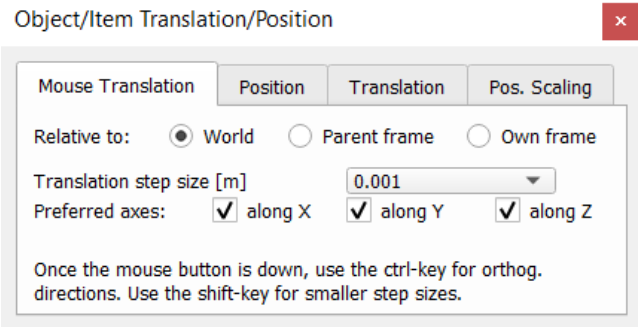

Figure 3: Change translational step size to 0.001 to reposition objects acurately.

3. Use revolute joints where 1 Degree of Freedom (DOF) rotational movement is required

- **Revolute joints have one DOF** and are used to describe **rotational movements** (with 1 DOF between objects.
- Their configuration is defined by **one value that represents the amount of rotation** about their **first reference frame's z-axis**.
- They can be used as **passive joints, or as active joints (motors)**.
- Click here to view the statements mentioned in CoppeliaSim's help files.
- In your ball balancing platform, **use revolute joints befittingly**.
- As an example, refer Figure 4 to understand the **need of ACTIVE revolute joint between *servo* and *servo_fin***.

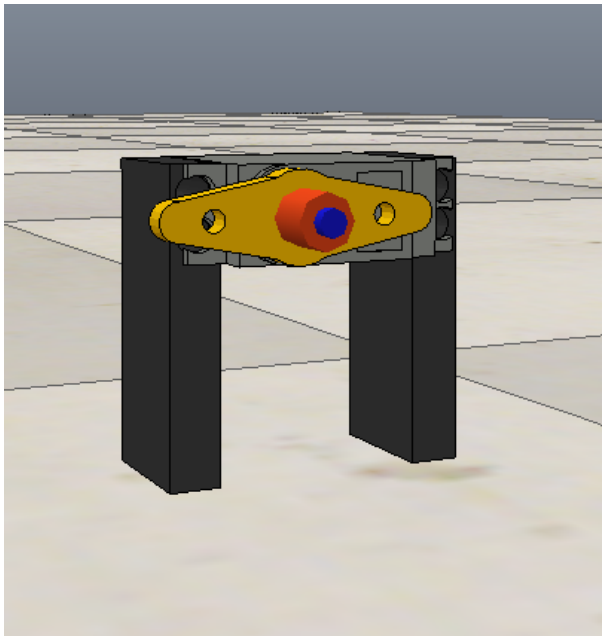

Figure 4: Placement of revolute joint between servo motor and fin.

4. Use spherical joints where 3 Degrees of Freedom (DOF) rotational movement is required

- **Spherical joints have three DOF** and are used to describe **rotational movements** (with 3 DOF) between objects.
- Their configuration is defined by **three values that represent the amount of rotation** around their **first reference frame's x-, y- and z-axis**.
- Spherical joints are **ALWAYS** passive joints, and cannot act as motors.

- Click here to view the statements mentioned in CoppeliaSim's help files.
- In your ball balancing platform, **use spherical joints befittingly**.
- As an example, refer Figure 5 to understand the **need of spherical joint between *connecting_rod* and *l_connector***.

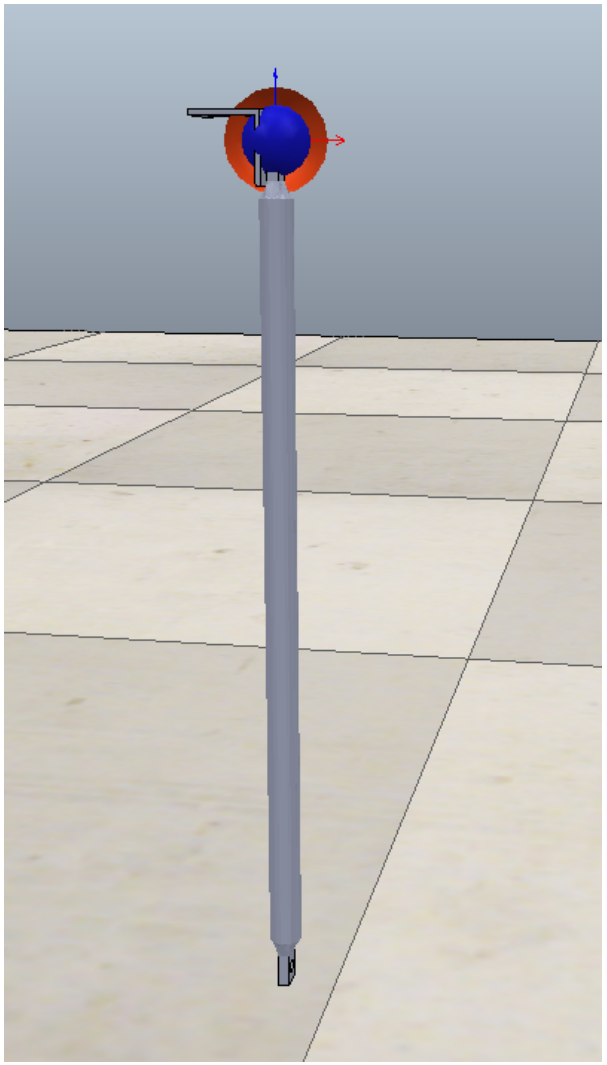

Figure 5: Placement of spherical joint between connecting_rod and l_connector.

- Refer this link to get an idea about the axes of spherical joint.
- When the ***servo*** motors **will rotate to pull/push**, the ***top_plate*** will tilt due to which a simple revolute joint (having 1 DOF) will not work.
- Linked dummies may work in CoppeliaSim simulation. However, from a practical perspective they can **NOT** be **used in place of spherical joints** in real world.

- Hence you can **NOT** use linked dummies as a replacement for this joint.

NOTE:

- Click here to learn about dummy properties in CoppeliaSim
- Click here to learn about designing dynamic simulations in CoppeliaSim

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5. Use force sensor only where a rigid link is required

- **Force sensors** are initially **rigid links** between two shapes that are able to measure transmitted forces and torques.
- Click here to view the statements mentioned in CoppeliaSim's help files.
- As an example, use force sensor between ***l_connector*** and ***top_plate*** as shown in Figure 6.

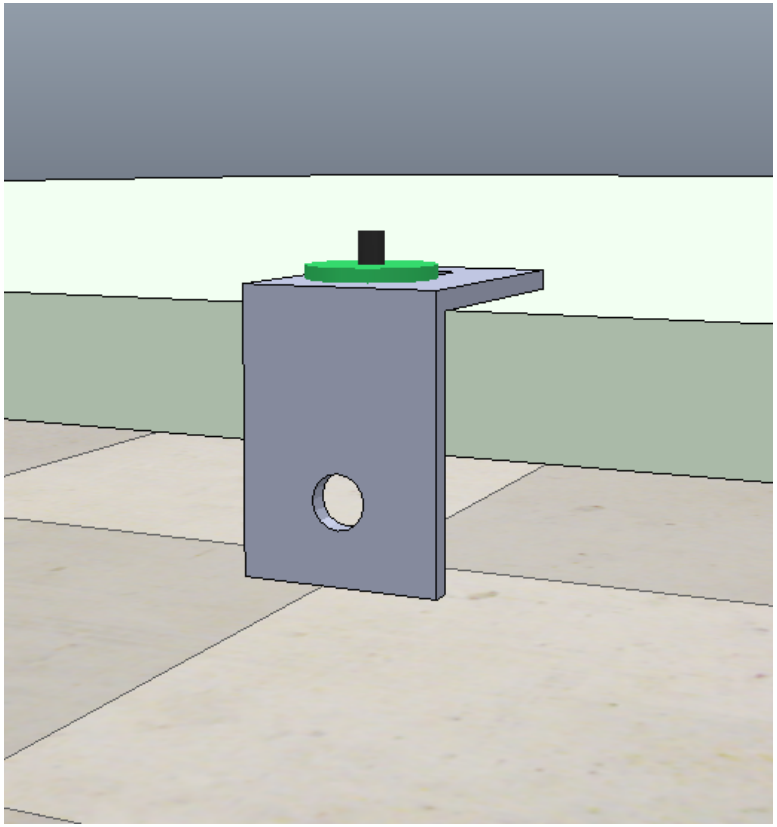

Figure 6: Placement of force sensor between l_connector and top_plate.

6. Initial position of servo fin should be such that the top plate is parallel to bas plate

- Refer Figure 7 to first understand the statement mentioned above.

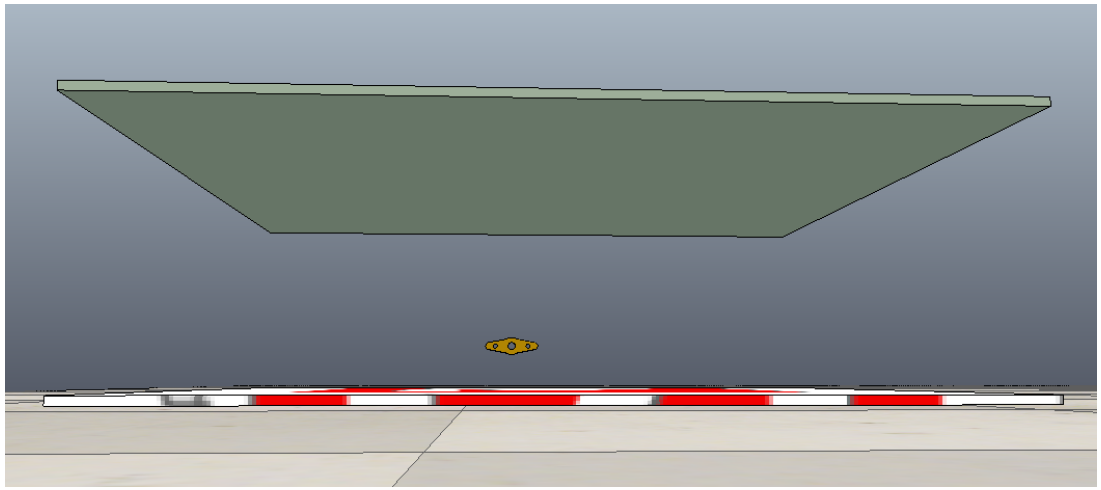

Figure 7: Orientation of servo_fin when top_plate is parallel to base_plate.

- When you will design your control logic in task 3, you will need to have a reference position/orientation to work with.
- Hence it is **recommended** to orient (**position of the servo_fin may not be same as shown i the Figure 7**) the servo fin as shown.
- This will ensure that the ***top_plate*** is parallel to ***base_plate*** for the initial position and **hence simplify the calculation and code**.

Note:

- The figures shown in this document are for explanation purposes only.
- The placement and/or orientation may or may not be similar in your design.
- Hence understand the concept shown and implement the same in your design.
- **Placement** along with **scene hierarchy** is very important for making a **CORRECT** design.

ALL THE BEST
