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## eYRC 2020-21: Nirikshak Bot (NB)

# [2] Theme Description

[ Last Updated on: **16th January 2020, 16:00 Hrs** ]

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- The arena shown in Figure 1 represents the quality test section of a manufacturing plant.
- In this theme, teams will design **2-DOF Ball Balancing Platforms** capable of **navigating the balls through mazes** placed on top of the said platforms.
- With a **combination of entry and exit points in the mazes**, the platforms should be able to **properly navigate and deliver the balls to their respective pre-defined locations**.
- A platform capable of delivering/passing all the balls within the stipulated time will be considered as **OK Tested!**

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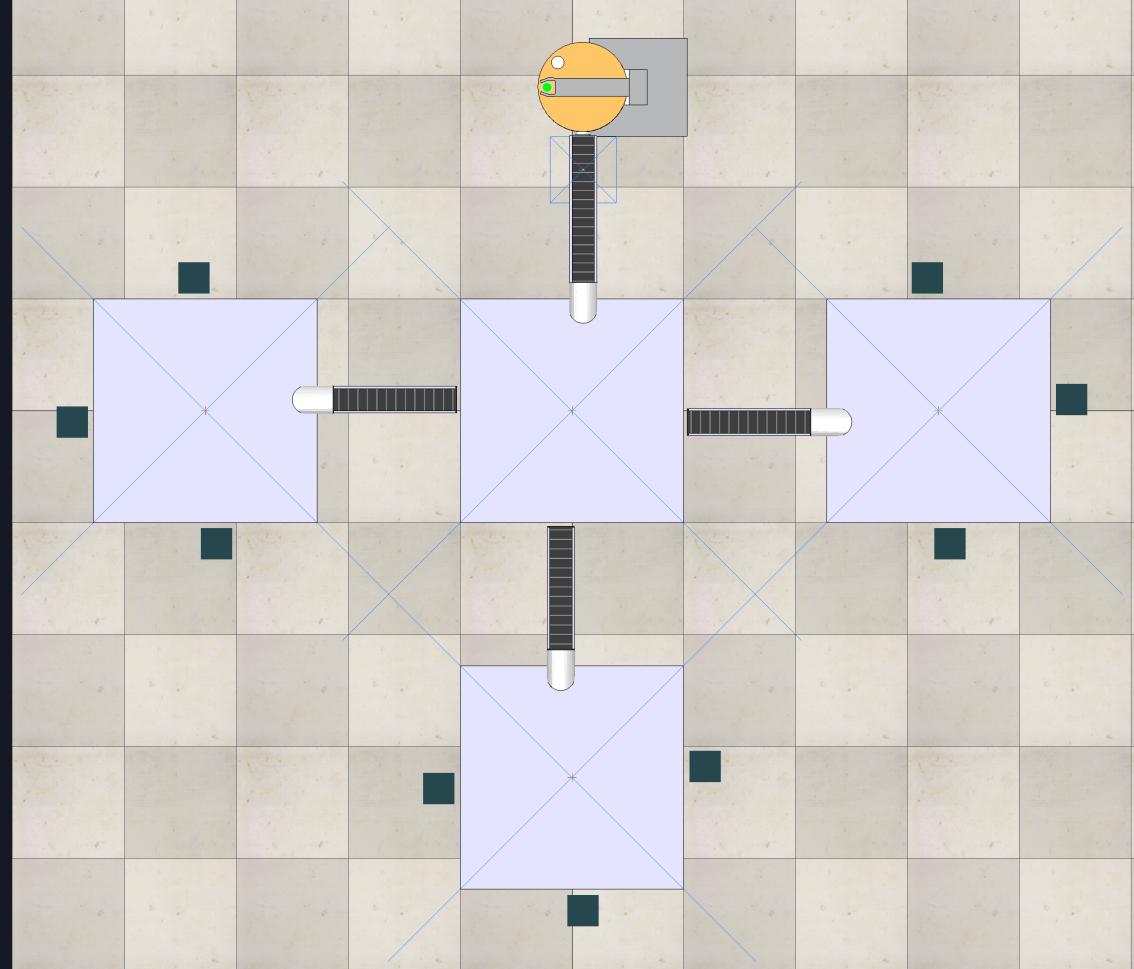


Figure 1: Arena design

## 1. Arena Components

- As shown in Figure 2, there are following components:
  - **four Platform Tables**
  - **four Conveyor Belts**
  - **one Ball Dispenser**
  - **few Collection Boxes** and
  - **five Vision Sensors**

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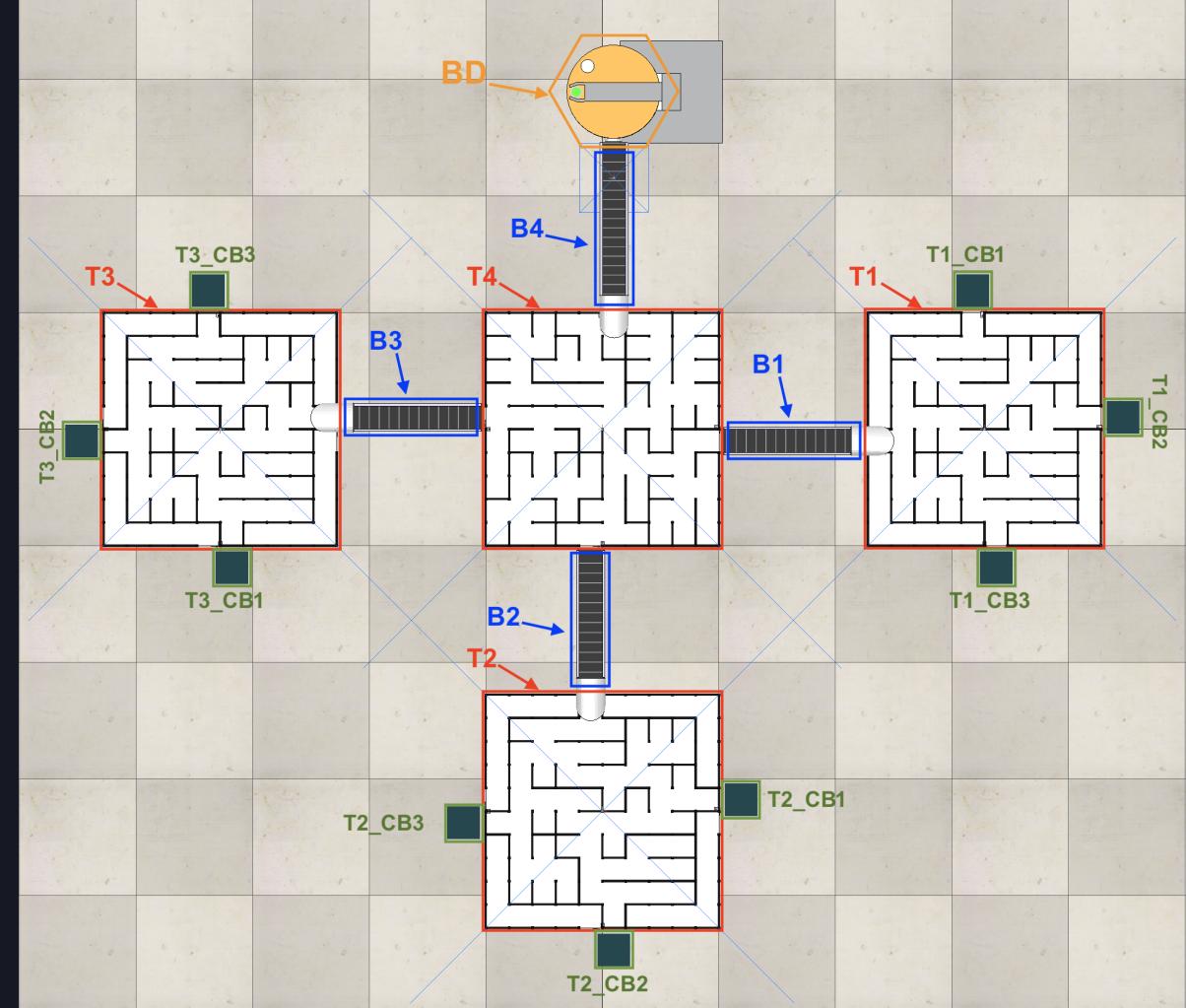


Figure 2: Arena design with Platform Tables

## 1. Platform Tables

- These are the Ball Balancing Platforms (designed by teams) with mazes generated on top of them.
- There are **four** such Platform Tables named as: **Table-4 (T4)**, **Table-3 (T3)**, **Table-2 (T2)** and **Table-1 (T1)**.
- These Platform Tables are indicated with **RED** rectangles in Figure 2.

## 2. Conveyor Belts



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- These are belts used to transfer balls
  - from **Ball Dispenser (BD)** to **Table-4 (T4)** and
  - from **Table-4 (T4)** to **Table-3 (T3) / Table-2 (T2) / Table-1 (T1)**.
- There are **four** such Conveyor Belts named as per the name of destination Platform Table as mentioned in Table 1.

Belt Name	Source of Ball	Destination of Ball
Conveyor-Belt-1 ( <b>B1</b> )	Table-4 ( <b>T4</b> )	Table-1 ( <b>T1</b> )
Conveyor-Belt-2 ( <b>B2</b> )	Table-4 ( <b>T4</b> )	Table-2 ( <b>T2</b> )
Conveyor-Belt-3 ( <b>B3</b> )	Table-4 ( <b>T4</b> )	Table-3 ( <b>T3</b> )
Conveyor-Belt-4 ( <b>B4</b> )	Ball Dispenser ( <b>BD</b> )	Table-4 ( <b>T4</b> )

Table 1: Conveyor Belt Naming Convention

- These belts are indicated with **BLUE** rectangles in Figure 2.

### 3. Ball Dispenser

- A mechanism shown in Figure 3, will dispense the balls on to the **B4** at a **regular interval** of **80 simulation seconds**.

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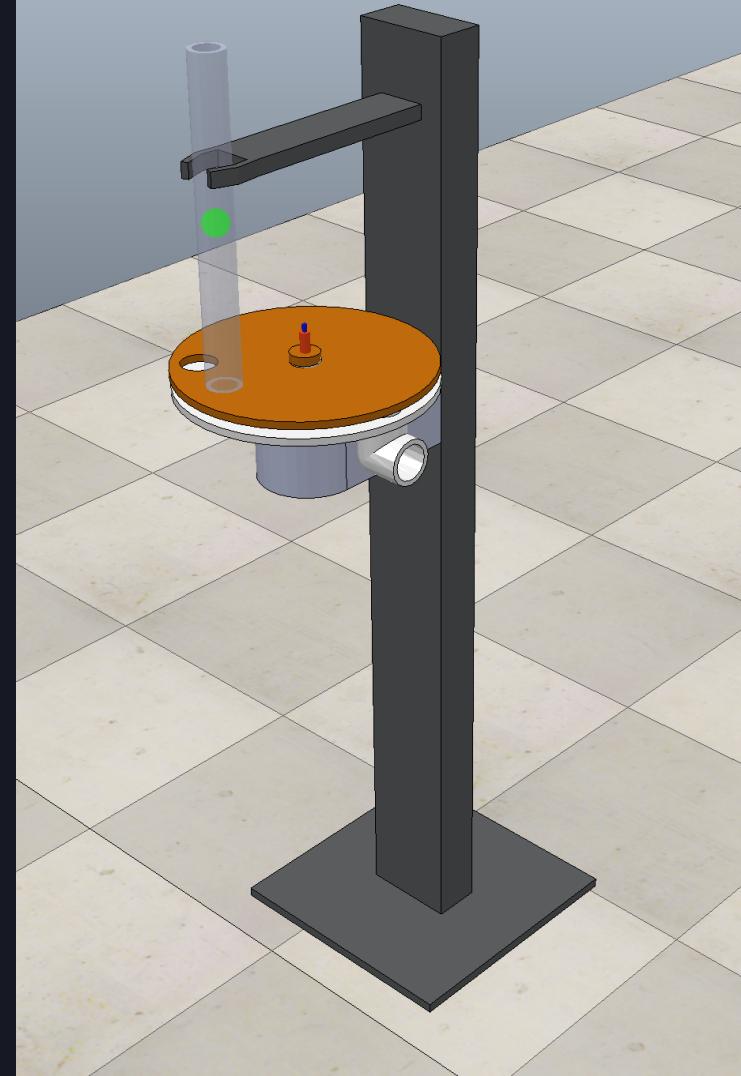


Figure 3: Ball Dispenser (BD) Mechanism

- The first ball will be dispensed at time  **$t = 0 \text{ sec}$** .
- This is indicated with an **ORANGE** hexagon in Figure 2.



#### 4. Collection Box



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- For each of the **three** Platform Tables (**T1**, **T2** and **T3**), there can be a **minimum of one** and **maximum of three** Collection Boxes associated in which the balls are to be dropped finally.
- These Collection Boxes are given the naming convention as mentioned in Table 2.

Platform Table Name	Collection Box 1 Name	Collection Box 2 Name	Collection Box 3 Name
Table-1 ( <b>T1</b> )	<b>T1_CB1</b>	<b>T1_CB2</b>	<b>T1_CB3</b>
Table-2 ( <b>T2</b> )	<b>T2_CB1</b>	<b>T2_CB2</b>	<b>T2_CB3</b>
Table-3 ( <b>T3</b> )	<b>T3_CB1</b>	<b>T3_CB2</b>	<b>T3_CB3</b>

Table 2: Collection Box Naming Convention

- These boxes are indicated with **GREEN** rectangles in Figure 2.

## 5. Vision Sensor

- There are **five** Vision Sensors in the Arena, out of which **four** are placed directly above the **four** Platform Tables coinciding with their center and looking downwards onto the Tables.
- The **fifth** Vision Sensor is placed above the Conveyor-Belt-4 (**B4**).
- These Vision Sensors are indicated with **RED** rectangles in Top and Side view of the Arena depicted in Figures 4 and 5.

Welcome to NB theme!

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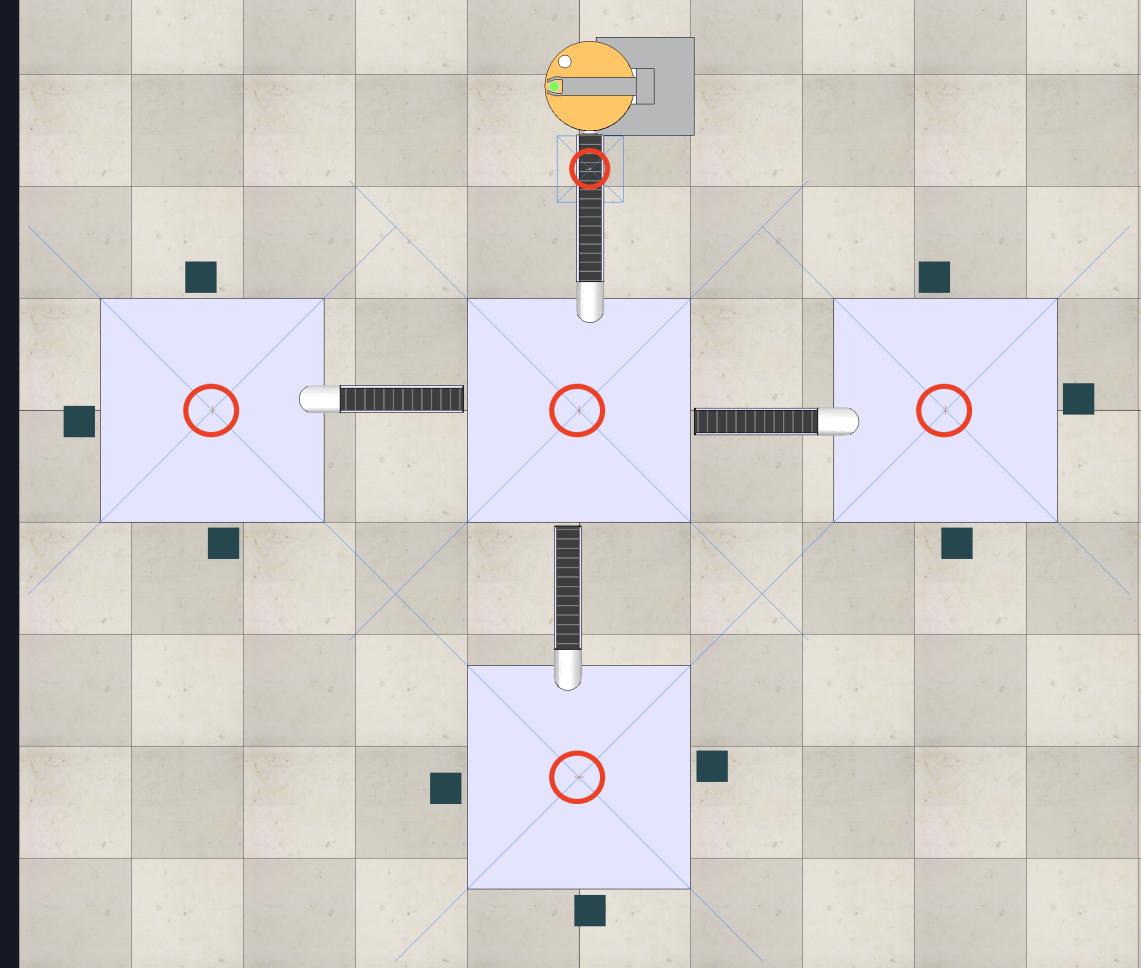


Figure 4: Top view of Arena with Vision Sensors

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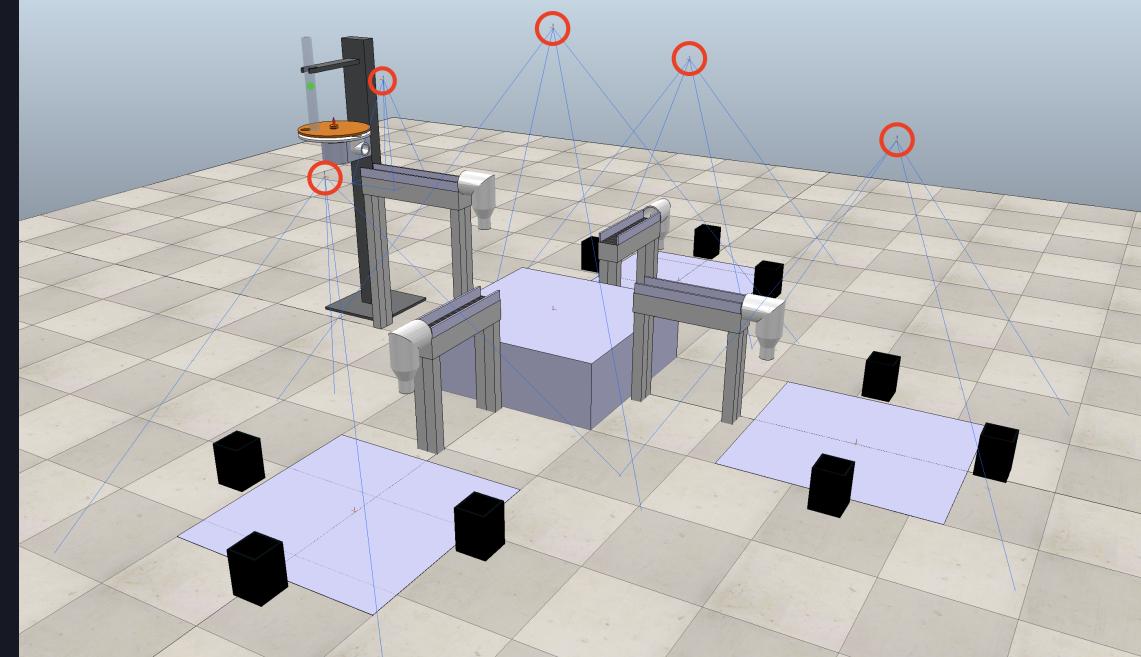


Figure 5: Side view of Arena with Vision Sensors

## 2. Theme Run Requirements

- Teams will be provided with the following files before the start of theme run:
  1. **arena\_scene.ttt** - This is the CoppeliaSim scene file in which the theme run will take place.
  2. **arena\_scene\_details.pdf** - This document will define the objects / elements of **arena\_scene.ttt**, their position, dimensions and properties.
  3. **ball\_details.json** - This JSON file provides the details of all balls that will be dispensed by the **BD**. The **color** and the **drop location** (i.e. a particular Collection Box) of each ball will be specified.
  4. **maze\_t1.jpg**, **maze\_t2.jpg**, **maze\_t3.jpg** and **maze\_t4.jpg** - These are the image files of the mazes to be generated on top of the four Platform Tables. These files are named according to the Platform Table on which that particular maze is to be generated.
    - **maze\_t1.jpg** - to be generated on **T1**
    - **maze\_t2.jpg** - to be generated on **T2**
    - **maze\_t3.jpg** - to be generated on **T3**
    - **maze\_t4.jpg** - to be generated on **T4**

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### 3. JSON File Description

- The JSON file `ball_details.json` consists of the details of all balls that will be dispensed by the **BD** in the following format:

```
{
    "red"      : ["T1_CB3", "T2_CB1"],
    "green"    : ["T3_CB2"],
    "blue"     : ["T1_CB1", "T3_CB1"]
}
```



**NOTE:** The above contents of a JSON file are to be considered as an example.

- The above dictionary conveys the following information:
  - Total number of balls to be dispensed by BD:** There are in total **five** balls that will be dispensed by the **BD**.
  - Color of each ball:** There will be **two red, one green** and **two blue** balls dispensed by the **BD** in *random order*.
  - Drop location of each ball:** The drop location i.e., the **name of Collection Box** in which balls are to be dropped, is given as **list of strings** corresponding to the **color of each ball**.
- Considering the above JSON file as an example, the following is its interpretation:
  - There will be **two red** balls. The first red ball when dispensed by the **BD**, is to be dropped in **T1\_CB3** and the second red ball is to be dropped in **T2\_CB1**.
  - Similarly, there will be **two blue** balls. The first blue ball when dispensed by the **BD** is to be dropped in **T1\_CB1** and the second blue ball to be dropped in **T3\_CB1**.
  - A **green** ball when dispensed by the **BD** is to be dropped in **T3\_CB2**.

**NOTE:**

- The balls will be dispensed by the **BD** in *random order*.
- This means that at the very beginning, the first ball dispensed by the **BD** may or may not be **red** in color.
- Similarly, at the very end, the last ball dispensed by the **BD** may or may not be **blue** in color.

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## 4. Goal of Theme

- There will be pre-defined number of balls and their drop locations that will be dispensed by the **BD** at **regular interval of 80 simulation seconds**, which can be determined from the **ball\_details.json** file provided before the theme run.
- The Platform Tables have to navigate each ball through the generated mazes and drop them in the respective designated Collection Box within the stipulated time frame.

## 5. Theme Run Sequence

- Before the theme run starts, teams will import their **Ball Balance Platform** design in **arena\_scene.ttt** file. The coordinates to which these platforms are to be positioned will be defined in **arena\_scene\_details.pdf**.
- Teams will start their Python client script, process the four maze image files provided using Image Processing and generate these mazes on top of the **four** Platform Tables in the **arena\_scene.ttt**. The maze generation takes place with the help of customisation Lua script(s) in CoppeliaSim.
- Once the simulation starts, the Ball Dispenser (**BD**) will start dispensing each ball at regular interval of **80 simulation seconds**.
- The **Theme Run Timer** will start **as soon as the first ball** is transferred on to Table-4 (**T4**) by Conveyor-Belt-4 (**B4**).
- **T4** has to navigate the ball through maze on it and pass the ball to the next table i.e., **T1** or **T2** or **T3** based on the designated drop location mentioned in **ball\_details.json** file.
- The next table will then navigate the ball through maze on it and drop the ball in the appropriate Collection Box (**CB**).
- The second ball will be dispensed at **80 simulation seconds** after the first ball was dispensed. This will repeat itself until the last ball is dispensed.
- The **Theme Run Timer** will **end after 480 simulation seconds** from the start of timer.
- The objective is to drop all the balls to their respective **CB** within **480 simulation seconds**.