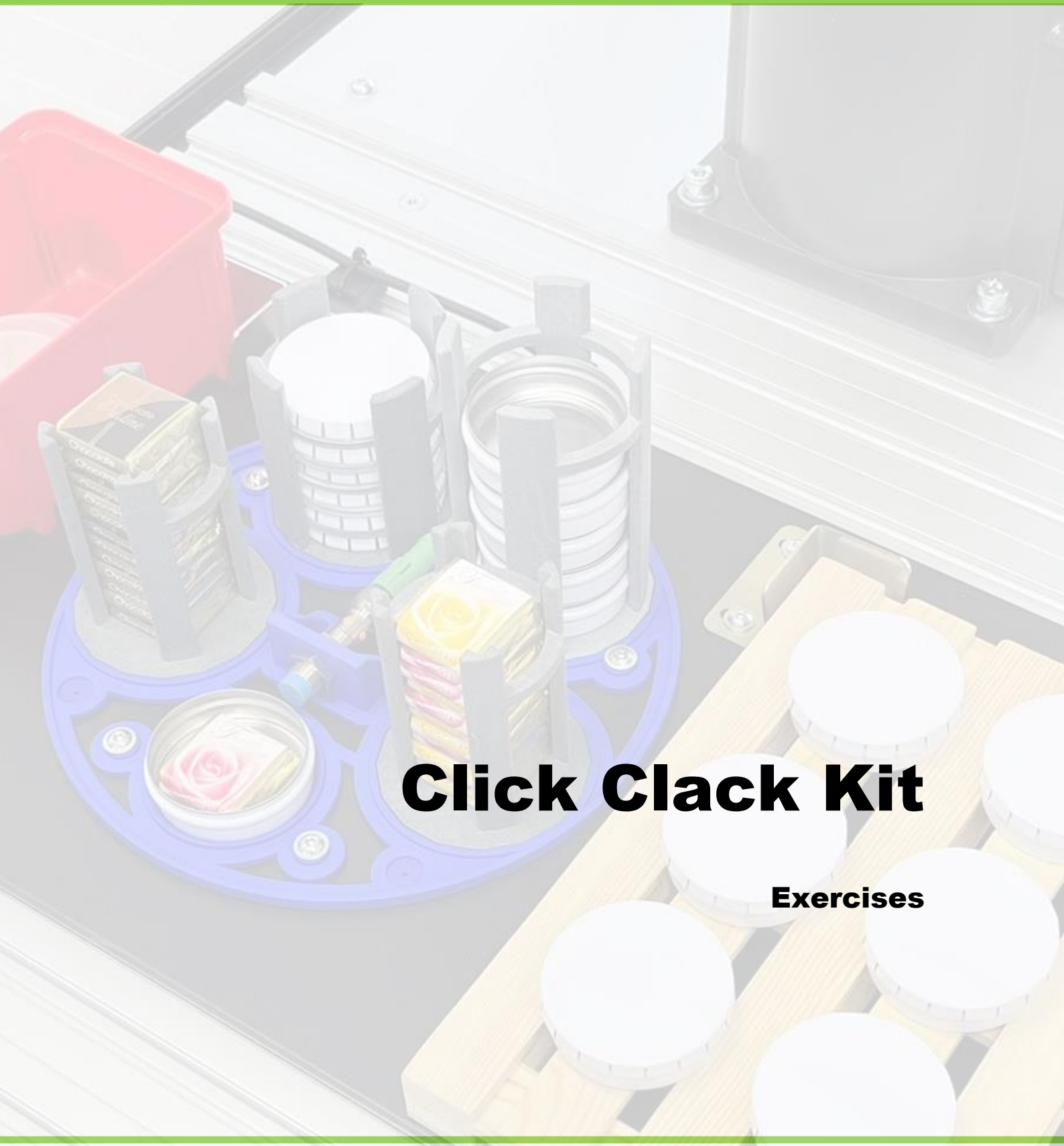

Click Clack Kit

Exercises

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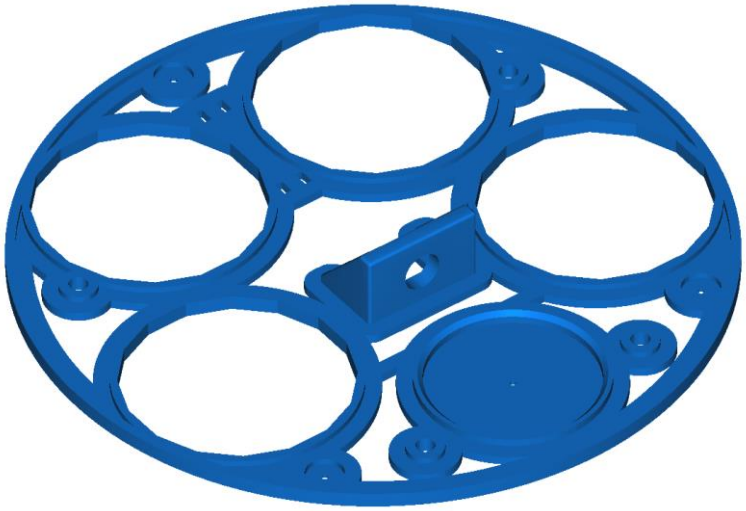
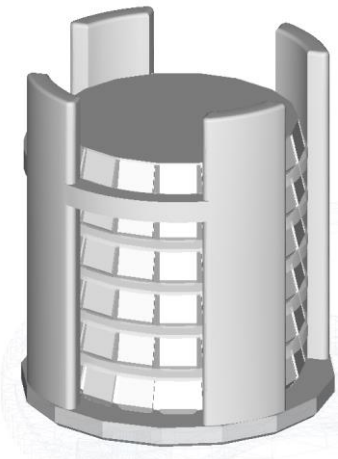
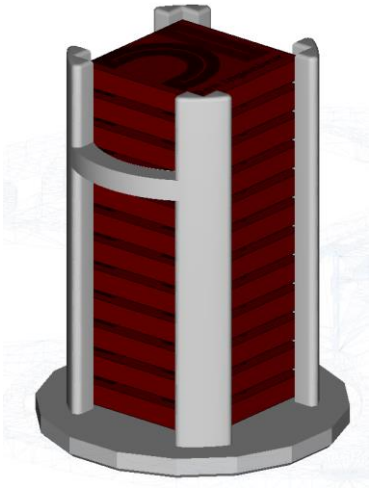
1 Context

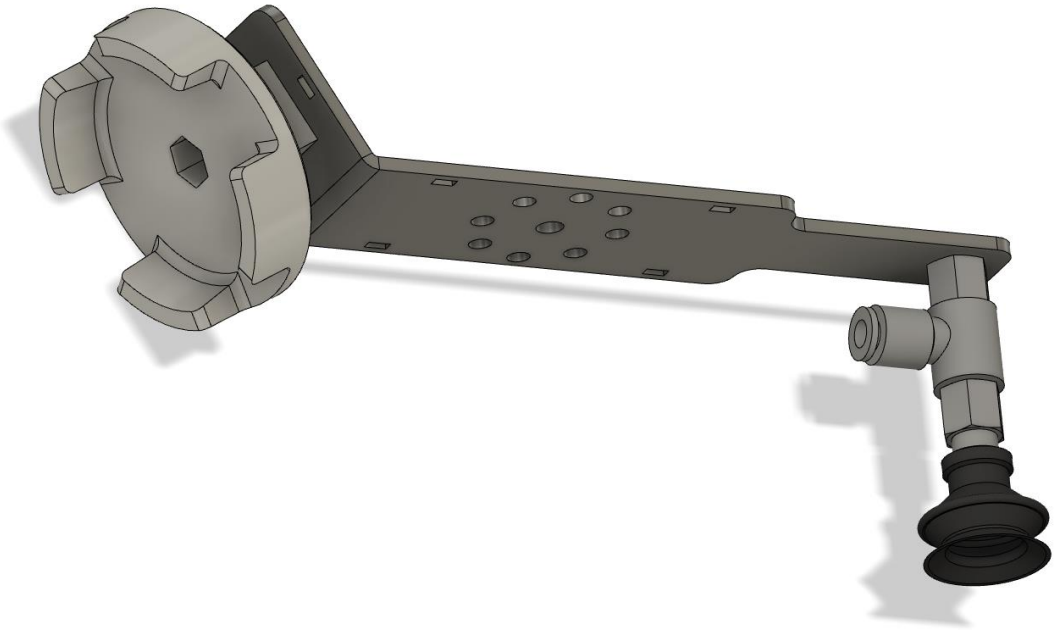
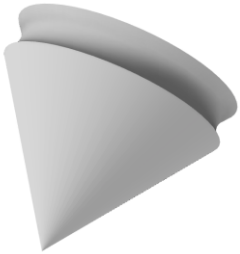
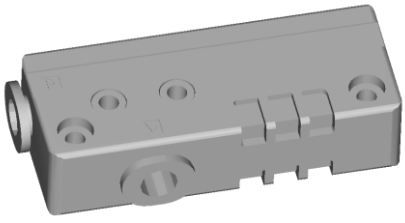
The trainees should develop a robot cell that will assemble promotional gifts (goodies) for a customer and to drop them on a pallet. The goodies are click clack cans filled with two different types of chocolate.

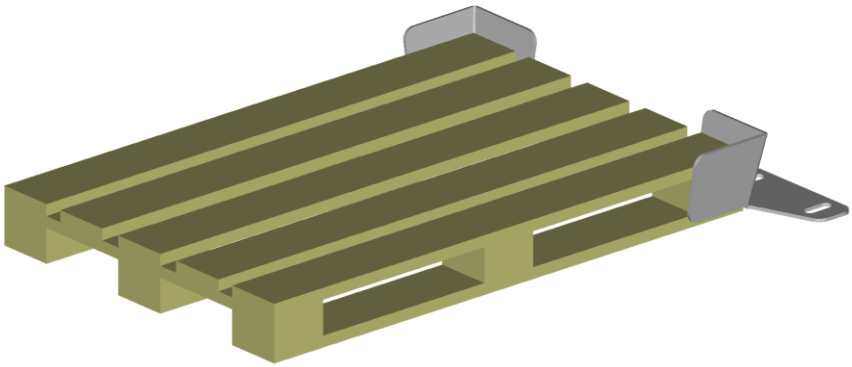
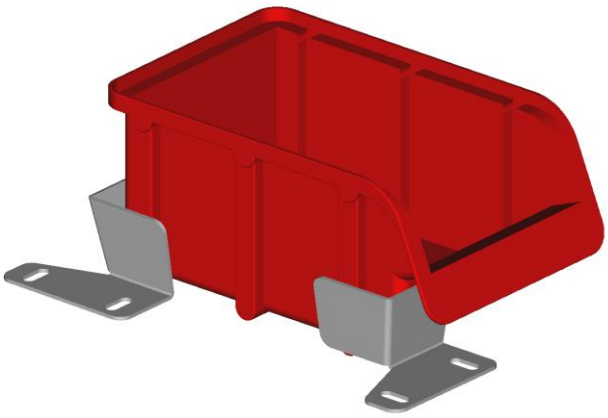
The job can be divided into three stages:

- Stage 1: Setup of the cell and the robot
- Stage 2: Programming of the robot (Basic task)
- Stage 3: Creation of an HMI, Visual inspection and documentation (Extension tasks)

2 Provided parts

1 assembly station locator to hold the 4 holders, the proximity switch and the assembled can		1 inductive proximity switch with cable
		
1 can body holder with 6 can bodies	**1 can lid holder with 6 can lids and 5 separation spacers**	**2 chocolate holders with 12 chocolates each (12 milk and 12 dark)**
		

<table>
<tr><th colspan="3">1 tool assembly with flange adaptor, suction cup, closing tool, screws and mounting pin</th></tr>
<tr><td colspan="3">  </td></tr>
<tr><th>1 TCP teaching pin for the suction cup</th><th>1 TCP teaching pin for the closing tool</th><th>1 adaptor M5 Male to 6mm Push In</th></tr>
<tr><td>  </td><td>  </td><td> 
</td></tr>
<tr><th>1 vacuum generator with 1m of air pipe</th><th>1 mounting bracket for vacuum generator</th><th></th></tr>
<tr><td>  </td><td>  </td><td></td></tr>
</table>

<table>
<tr><th>1 pillar, 3 LEDs (red, blue, green)</th><th>1 IO block</th></tr>
<tr><td>  </td><td>  </td></tr>
<tr><th colspan="2">1 pallet and 2 pallet guides</th></tr>
<tr><td colspan="2">  </td></tr>
<tr><th colspan="2">1 storage bin for the separation spacers with 1 locator</th></tr>
<tr><td colspan="2">  </td></tr>
</table>

3 Setup of the cell and robot

3.1 Goal of this stage

The goal of this stage is to install all parts needed to perform the basic task and to setup the robot cell. This should be done in Roboguide and in the real cell.

3.2 Steps

The setup of the robot cell can be split into the following steps:

Setup of a robot cell
Planning of a cell layout in Roboguide, including: • Creation of all tools. • Assignment of parts to their respective tool. • Creation of all fixtures and machines. • Creation of all CAD files that might not have been provided. • Check reachability to all crucial parts.
Mechanical, pneumatic and electrical installation of all parts in the real cell.
Setup of all needed controller inputs and outputs.
Setup of at least one reference position for the Home position.
Writing of macro programs and assignment to the user keys.
Setup of the arm- and payloads.
Teaching of User Tools and User Frames.
Configuration of DCS (working zone, robot model, user model).
Setup of the host communication (TCP/IP settings and access rights).

3.3 Background information for cell setup

3.3.1 Pneumatic connections

The LR Mate operator manual and in particular chapter 5.1 are provided in case you need to look up details about the air supply on the robot.

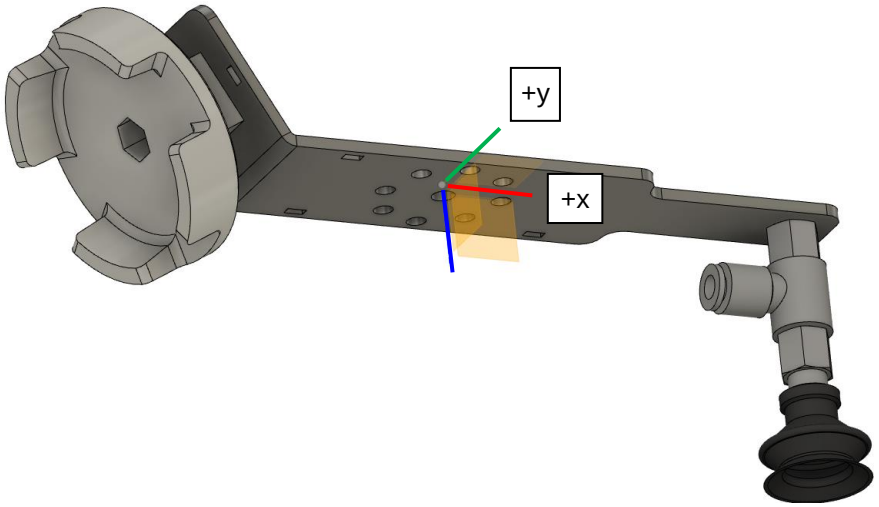
3.3.2 Mass of parts

Tool assembly:	150g
Can complete with 3 chocolates:	35g
Vacuum generator with bracket and hose:	45g

3.3.3 Tool assembly

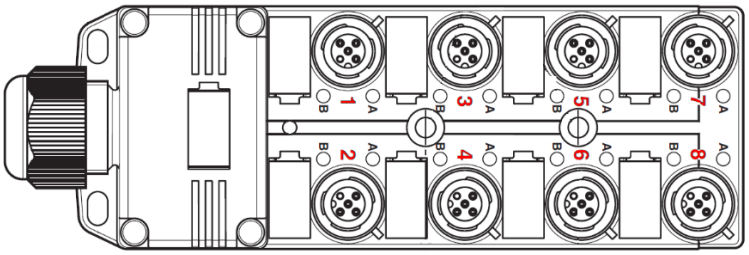
The engineer who developed the tool assembly gives you the information below about the tool assembly when carrying a can assembly with 3 chocolates. The values and the drawing are taken from his CAD software, so be careful about the given directions of the axes. Consider also defining two payloads, one with and one without a picked part.

Centre of gravity relative to the origin of the drawing:	x = -9,0 mm y = 0,0 mm z = +1,5 mm
Moments of inertia relative to centre of gravity:	I_{XX} = 0,10 kgfcms^2 I_{YY} = 0,90 kgfcms^2 I_{ZZ} = 0,80 kgfcms^2



3.3.4 IO Block

The IO block has sockets numbered 1 to 8 as shown below:



The robot I/O is pre-connected to the sockets as shown in the table below:

Socket	A (Pin 4)	B (Pin 2)
1	DI[101]	DI[102]
2	DI[103]	DI[104]
3	DI[105]	DI[106]
4	DI[107]	DI[108]
5	DO[101]	DO[102]
6	DO[103]	DO[104]
7	DO[105]	DO[106]
8	DO[107]	DO[108]

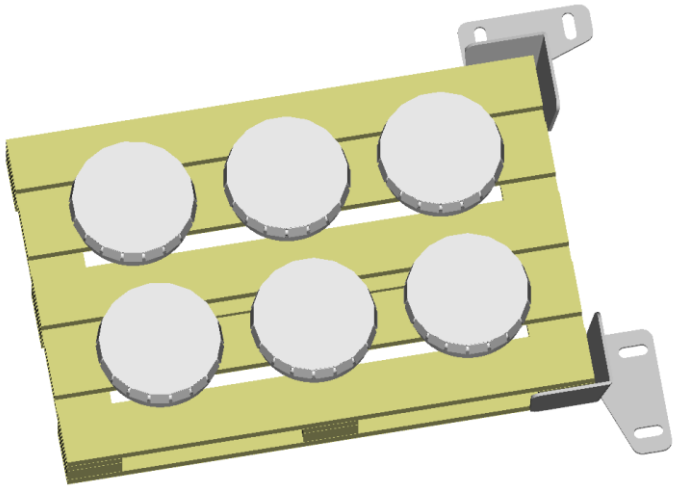
4 Basic task

The goal of this stage is to hard code a professional robot program that will realise the following click clack can order:

- 5 click clack cans
- 1 milk and 1 dark chocolate per can

The completed cans should be dropped evenly spaced on the pallet according to the below pattern. Production must start and end at the chosen HOME position.

The separation spacers are to be dropped into the storage bin.



Data driven programming:

The customer requests that he can enter the vertical distance between two parts in the 4 holders in numeric registers so that the robot motions will adapt to product variations.

Error handling:

Your program should detect at least the two following error situations and react by appropriate prompt messages.

1. The robot is not in Home position at program start.
2. The proximity switch detects a part remain at the assembly position before bringing in a new can body.

Details about the creation of prompt messages can be found in Fanuc Educational Cell Exercise 12.

LED tower:

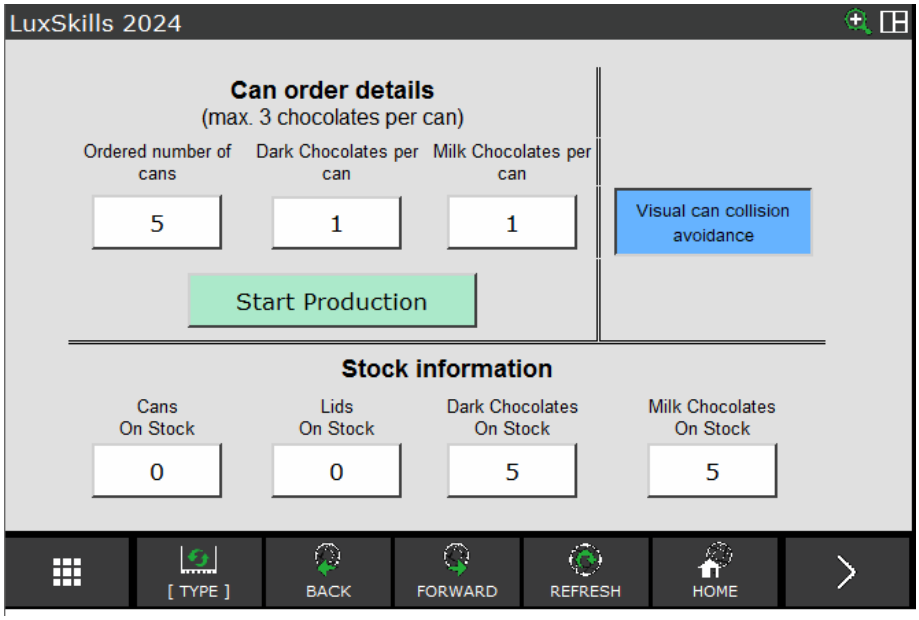
Below you can find instructions how the LEDs should be used. A bonus could be to make the red LED blink with a frequency of 1Hz when enabled.

Operating Mode	Red LED	Green LED
Main program running	Enabled	Disabled
Main program finished	Disabled	Enabled

5 Extension tasks

5.1 Extension task 1: HMI

The customer asks for a specific HMI on the teach pendant to allow him to customize his orders. The HMI must contain at least the information shown below and respect the given layout. Trainees are however free to add whatever information they think that could be of use for the customer, even on a second page.



Details about the creation of an HMI can be found in Fanuc Educational Cell Exercise 10.

Details:

Field or Button	Details
Nb. of cans	Number of ordered cans, variable between 1 and 5.
Dark Chocolates per can	Variable between 0 and 3.
Milk Chocolates per can	Variable between 0 and 3.
Start Production	Button to start the assembly of the cans.
Cans On Stock	Shows currently available can bodies in the can body holder during production but can also be manually adapted in case of refilling.
Lids On Stock	Similar to "Cans On Stock"
Dark Chocolates On Stock	Similar to "Cans On Stock"
Milk Chocolates On Stock	Similar to "Cans On Stock"
Visual can collision avoidance	Button to enable or disable the extension task 2. It should be enabled by default.

5.2 Extension Task 2: Visual can collision avoidance

The customer wants to make sure that there is no risk of collision between parts remaining on the assembly position or pallet - even if the robot operation is interrupted or disturbed manually. Trainees should extend their program such that the camera inspects at appropriate times that the assembly position and the pallet are free of obstructive parts.

The blue LED should light up for a limited time after camera inspection process to signal that no obstructive part was detected.

The iRVision reference operator manual and in particular chapters 2 and 3.7 are provided.

There are solutions with or without a camera calibration.

To activate the Vision simulation in Roboguide:

- Cell Browser / Vision / Right Click / Enable Vision Simulation
- Cell Browser / Vision / Right Click / Vision Properties / General / Port / Device / SensorUnit1

A restart of Roboguide might be necessary in case you get error messages.

5.3 Digital twin

Trainees should make the Roboguide cell as realistic as possible by animating the tools, writing simulation programs, simulating vision processes and providing an I/O panel for manipulating inputs (see Menu / Tools / IO Panel Utility).

5.4 Documentation

Trainees are asked to prepare a structured technical documentation of the developed application based on the Word template document provided. This documentation should contain all the information necessary to run, maintain and troubleshoot the cell after you leave site.

Consider documenting the following points:

- Cell overview
- Tools
  - Tool coordinate systems (location and orientation)
  - UTOOL teaching instructions
- Payload and armload settings
- DCS settings
- Home position
- Fixtures
  - User coordinate system (location and orientation)
  - UFRAME teaching instructions
  - Important points (location and orientation)
- I/O
  - I/O used
  - Connected devices
- Network settings
- List of program names
- Registers used
- Basic Operator Instructions (How to run the cell?)
- HMI pages
- Vision settings