Task Description:

In groups of 3 students each, you are required to:

(a) Design a full functioning production line on a simulation platform (ex. FACTORY I/O)

(b) Use Siemens TIA portal software in order to control the simulated production line while incorporating the studied functions in the design process of such application.

(c) Design a suitable HMI module in order to monitor and visualize the various states of the simulated production line and supply supervisory control commands

(d) Utilize field-related alarms for the detection of hardware and sequence faults.

The mentioned production line performs the tasks of machining, sorting and assembly starting from raw materials to finished assembled products.

Production Line Components:

1. **Feeding unit:**

   This unit can be considered as the beginning of your production line, where it generates the random raw materials. It also incorporates a pick & place robot which can be used to place the fed part to the beginning of your line.

Fig. 1

2. **Machining center:**

   The Machining Center is a station used to manufacture lids and bases from raw materials. First, the articulated robot waits for raw material to be placed at the entry bay. When new material is detected, it is loaded into the CNC machine which will start manufacturing an item. Each item type takes a different interval of time to be produced (lids: 6 seconds; bases: 3 seconds). Once the operation is complete, the robot places the item on the exit bay.

Fig. 2

3. **Assembly unit:**
   This part can be used to assemble Lids on Bases or pick and place items from one place to another.
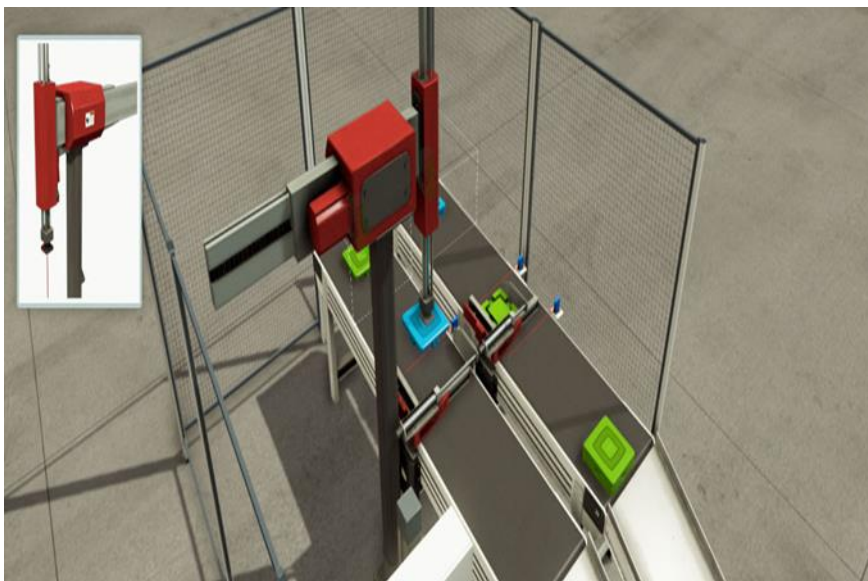   To guarantee a correct fit, bases and lids should be properly aligned by positioning bars.

Fig. 3

Implementation Guidelines:

a) Design a full production line whose operation is as follows:
   1. Generate random raw materials in the feeding station (Green or Blue).
   2. Move them using the basic pick and place robot into the output conveyor of the feeding unit.
   3. Use the machining center station (or multiples of them) to fabricate different products: blue lids, blue bases, green lids or green bases.
   4. Use the assembly station (or multiples of them) to assemble full green or blue products.

5. Sort the products into their designated removers (or storage areas) according to their colour.
6. Keep track of the finished products of each colour using a suitable interface.
7. Stop the production line when the given number of products of each colour is reached.

b) Program the production line to achieve the required process control using Siemens TIA portal software.

c) Design a suitable HMI interface on TIA portal to indicate the state of each station in the production line.

d) Use analog configurations on belt drive of Feeding unit and Assembly unit

e) Use analog and digital configurations on pick and place unit embedded in feeding and assembly units

f) Control the speed of the conveyors according to the queue and the status of the machine center

g) build a fault detection system for feeding and assembly unit and machine center

h) Utilize field-related alarms for the detection of hardware and sequence faults.

i) Prepare a technical report about the task highlighting your results and discussing your developed system performance. The report shall include the contribution of each team member in performing all task activities in a tabular form.

Note: Naturally, you will need to add more components to the mentioned stations (ex. indexing tables, vision sensors, etc.) in order to complete your line. Access to the description of all components in the FACTORY I/O library can be accessed through the following link: https://docs.factoryio.com/manual/parts/

Deliverables:

1. Software TIA portal code
2. HMI interface on TIA portal
3. SIL/HIL simulation of the automated production line
4. A technical report of the task highlighting your results and discussing your developed system performance. The report shall include the contribution of each team member in performing all task activities in a tabular form.

Date of Submission: Week 13