



Spring Semester, 2022

MCT 333: Mechatronic Systems Design

Sheet 1: Design Methodology for Mechatronic Systems

1. Define the objectives of the VDI 2206 guidelines.
2. Sketch the basic structure of the mechatronics system according to the VDI 2206.
3. Verification and validation are two essential terms of the V model. Locate these terms on their proper position of the V model and explain their function in designing the mechatronics system.
4. For painting mass-produced articles (kitchen appliances, audio and video equipment, aluminum wheel rims), painting systems in the form of continuous lines are often used. On these, the objects to be painted pass continuously through the system on a conveyor belt. The paint is applied by a number of spraying units, the oscillating movement of which runs either vertically (for the side surfaces of the object) or horizontally (for the upper side of the object) as shown in Figure 1. According to VDI 2206, design a mechatronic system for this process.

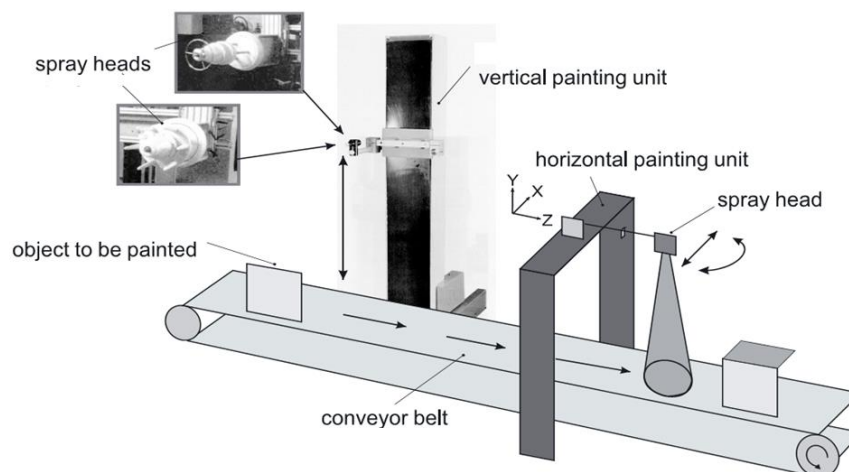


Figure 1

- A bottling plant uses an automated mechanism for filling the containers and transporting them from one point to another as shown in .5
6. Figure 2. The sensors monitor the amount of solid or liquid filled. A conveyor mechanism transports the containers. Under the concept of VDI 2206, design a mechatronic system for the case described. Identify the types and features of sensors you use, describe how the system works and explain how you are going to interface and control the system. Make suitable sketches if needed.

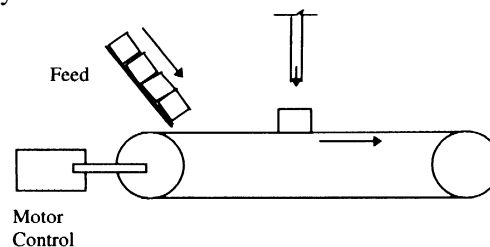


Figure 2

7. In Figure 3, a production assembly line which features an assembly installation of a product with transfer of the workpiece carriers. This assembly line consists of seven modules: A, B, C, D, E, and F as described in Table 1. As a finished module (10) is removed at the end of the assembly line by module A, the workpiece carrier (9) is gripped from below by suction cups (4) in the module (A), lowered and returned below the transfer line (G). The workpiece carrier (9) is then lifted and placed back at the beginning of the line by the lifting and transferring module (A). As all the workpiece carriers are in immediate juxtaposition without gaps, the effect of this is to index the entire chain of carriers forward by one unit. The robot module (C) is used to handle the new parts (3) to the work piece carrier (9). The small components are fed and arranged via vibratory feeders to the stations D and E to be assembled together. The whole assembly process can be produced complicated parts from standard components. The module F is used to remove the assembled product (10) out the assembly line.

Using system design approaches and VDI 2206 guidelines to design mechatronic systems:

- 1- Find the system requirements list for the whole production line and for each station module
- 2- Identify the functional structure diagram for each station module and their relation to each other
- 3- Identify the best solutions including mechanisms, sensors and actuators for each module (A, B, C, D, E and F)
- 4- Draw the system layout for the whole production line including all modules, mechanics, electronics and control.

Table 1: Assembly transfer line components.

No.	Description	No.	Description
1	Lifting slide unit	8	Gripper
2	Linear transfer slide	9	Work piece carrier
3	Assembly module (part 1)	10	Finished module
4	Suction cup	11	Lateral guide of the transfer line
5	Machine frame	12	Part 2 of the assembled part delivered to assembly D via vibratory feeder
6	Vibrator feeder for small work piece	13	Part 3 of the assembled part delivered to assembly E via vibratory feeder
7	Pick and place unit		
A	Work piece carrier unit for transferring and return to the start position	E	Sub-assembly stage 2
B	Vibratory feeder unit for rearrange and feed small products to the grippers. There are three vibratory feeder units for providing the components to be assembled in stages D and E	F	Handling Robot stage for removing assembled product (10) out the assembly line
C	Robot handling unit to move the assembly module (3) to the Work piece carrier (9)	G	Transfer line and assembly stages
D	Sub-assembly stage 1		

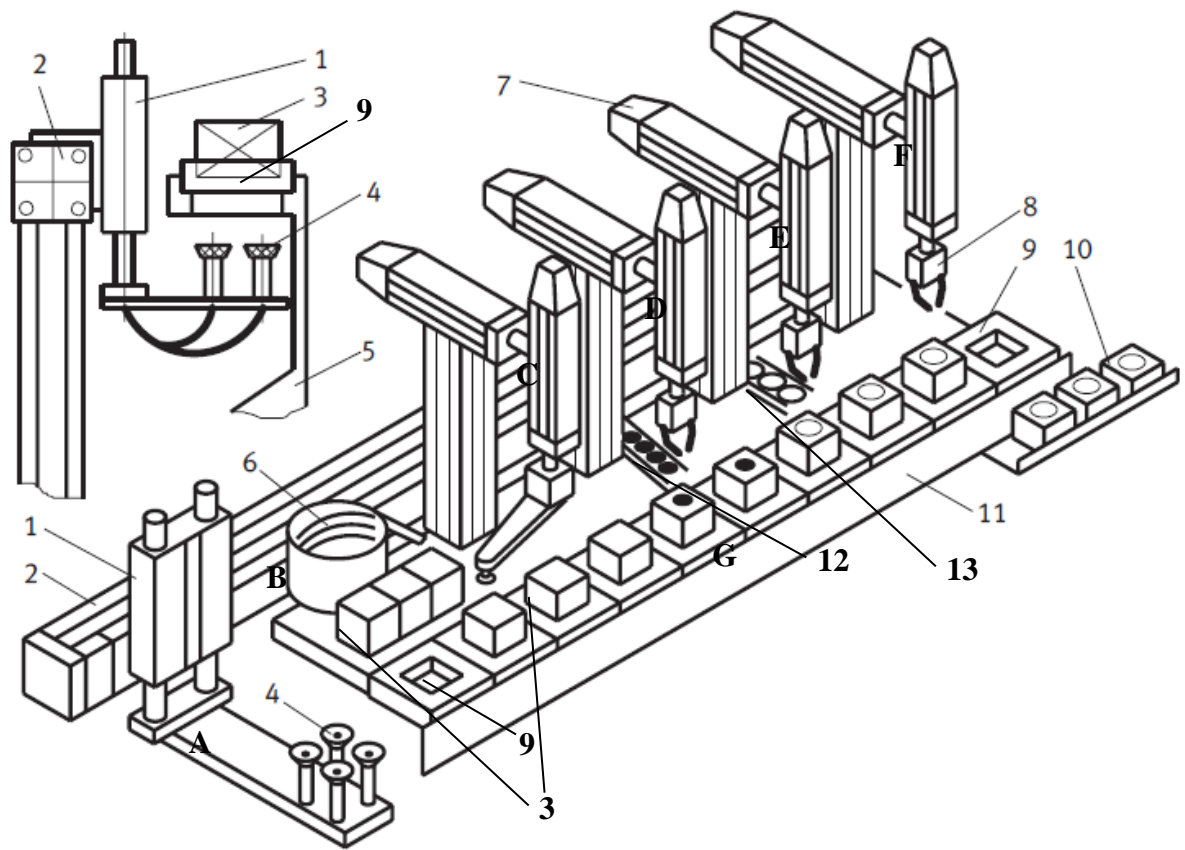


Figure 3: Assembly transfer line