Automated Product Assembly/Disassembly Station Requirements

GENERAL CUSTOMER REQUIREMENTS OF THE SYSTEM:

A customer asked you, as engineers work in a company, to develop an endless compact modular mechatronic
system that can be used for teaching and training purposes for mechatronic students and engineers. Thry wants this system to perform endless assembly and disassembly processes of a assembled cube is hollow and consists of two pieces at least (If you want to have assembled cube of three pieces, you can include a third part inserted inside the hollow cube). He/She described that production process will be carried out through five stages which should include 1) feeding materials, 2) transporting and handling, 3) assembly and pressing, 4) sorting and storing, and finally 5) disassembly and return back to the main feeding deposit.

He asked the engineers to divide this endless assembly and disassembly production line into independent five stations which can be quickly assembled and integrated together to perform the main stages and functions. He/She gives the engineers/designers freedom to divide the system functions between these five stations in order to have compact and fully automated production line which can easily integrated together. However, he asked that each station should be able to perform their functions independently from the rest of the stations if he/she wants to test each system individual. So, each station can perform as standalone mechatronic system and integrate with other stations when needed to provide the full function of the compact production line. He stated that the five stations can be divided based on the system stages (each station for one stage) or it can be divided to include portions or more of several stages as engineers see to satisfy the compactness, independency, and easy integration requirements. He described the process in each stage as follows:

1. Feeding materials:

This is the first stage in the production process by feeding the correct cube pieces to the assembly unit. The cube pieces can be stacked in two magazines at least. The fed cube pieces can be provided in different colours or/and materials which will need to be sorted in the storage station into two categories. The customer asked the engineers to choose the category classifications either based on one of colour, material or weight differences (you have the flexibility to choose which classification method to be used). The only constraint is that it should be classified into two classes e.g (black/white, plastic/aluminum, or weight difference (light/average).

2. Transporting and handling:

This stage is important to transfer the pieces and assembled parts between stages e.g: transfer cube halves from feeding magazines to the assembly process place, transfer assembled cubes from assembly place to the sorting process place, transfer cubes from sorting place to the storage stage based on their class (either colour, material or weight differences). Then transportation form the storage area to the disassembly area, and finally transportation for disassembly to their first place in the feeding magazine depository. The transportation mechanism can be implemented either by long conveyor or short conveyors going through the whole stages or using some transportations and handling mechanisms such as Cartesian or polar mechanism/robot.

3. Assembly and pressing:

This is the process used to join the cube parts together. The engineers have the flexibility to design the fitting and assembling techniques of the cube parts. It can be based on either pinned interference fit structure, snap fit joining for plastic products or any other arrangements for assembly. The cube should be equal to 50×50×50 mm after assembly.

4. Sorting and storing:

In this stage, the assembled cubes were classified into two classes according to the designer's opinion and then stored on horizontal shelves. The cubes should be stored in this shelves for 2 minutes before it is be taken for disassembly and return back to the first feeding stage.

5. Disassembly and return back to the main feeding deposit:

In this stage, the assembled cubes will be taken from the storage area according to their class and disassembled and feedback the main components to their first place in the magazine depositories.

Requirement constraints:

1. The maximum size of the integrated system should be <190cm×100cm×70cm. The height constraint as it will placed on lab tables during testing. The smaller the size, it would be better.
2. The total weight of the whole system after integration including control operation units of all stations and everything should be less than 80kg.
3. The cube dimension should be equal to 50×50×50 mm after assembly.
4. Cost