Additional exercise 2

Automatic machining cell
An automated production cell consists of a CNC (Computer Numerical Control) lathe, a CNC mill and an industrial robot. Producing the final product requires both turning and milling. The production cycle follows the following pattern.

- Casted aluminum billets are brought to the cell in a customized pallet.
- Robot loads one billet to the lathe for the first phase of machining.
- After turning, the robot unloads the billet from lathe and loads it to the mill for the second phase of machining.
- After milling, the robot unloads the finished product from the mill and loads it back on the pallet.

The billets are initially roughly arranged according to a known pattern on the pallet but their positions or orientations are not exactly known. The surface quality and dimensions of the billets after casting are not ideal and it is possible that there are also parts with failed casting.

1. Choose suitable sensors that are required to complete the process succesfully. Justify your choices. Explain also what kind of a gripper could be used to lift the billets. The production cell works autonomously so pay attention to reliability and error-detecting. Concentrate only on the billet changing process. The industrial robot knows its position with its internal sensors and positioning of the spindles in the milling and turning machines is taken care by these machines according to the instructions given to them.
2. Present the rough logic of one manufacturing cycle (from one casted billet to one finished product). What sensor data is collected in each step and what kind of communication is required between the machines and the automation system controlling them.

For example:

1. Manufacturing cycle is started. Pallet is present and in right position (detected with sensor x and y)
2. Billet from the first occupied pallet slot is detected and recognized with sensor z. Billet is picked and successful picking is confirmed with sensor k...
3. ...
4. ...

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- Part 1

Part 1

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