Machine programming

1 *Find words/phrases corresponding to the translations below in the text which follows.*

Par. 1: a. insieme (n.) .....
b. eseguite .....
c. fornisce .....

Par. 2: d. a sua volta .....
e. correttamente .....
f. comporta/implica .....

Par. 3: g. caratteristiche .....

Par. 4: h. richiedere .....
i. tendenza .....

Par. 5: j. fattore di rischio .....
k. scoprire .....

Par. 6: l. di conseguenza .....

Par. 7: m. portare .....

Par. 1 – The **programmed instructions** determine the set of actions that is to be accomplished automatically by the system. The program specifies what the automated system should do and how its various components must function in order to give the desired result. The content of the program varies considerably from system to system. In relatively simple systems, the program consists of a limited number of well-defined actions that are performed continuously and repeatedly in the proper sequence with no deviation from one cycle to the next. In more complex systems, the number of commands could be quite large, and the level of detail in each command could be significantly greater. In relatively sophisticated systems, the program provides for the sequence of actions to be altered in response to variations in raw materials or other operating conditions.

Par. 2 – Programming commands are linked to **feedback control** in an automated system. The program establishes the sequence of values for the inputs (set points) of the various feedback control loops that make up the automated system. A given programming command may specify the set point for the **feedback loop**, which in turn controls some action that the system is to accomplish. In effect, the purpose of the feedback loop is to verify that the programmed step has been carried out. For example, in a robot controller, the program might specify that the arm is to move to a designated position, and the feedback control system is used to verify that the move has been correctly made. Some of the programmed commands may be executed in a simple open-loop fashion (without the need for a feedback loop to verify that the command has been properly carried out). For example, a command to flip an electrical switch may not require feedback. The need for feedback control in an automated system might arise when there are variations in the raw materials being fed into a production process. The system must take these variations into consideration by making adjustments in its controlled actions. Without feedback, the system would be unable to exert sufficient control over the quality of the process output.
The programmed commands may be contained on mechanical devices (e.g., mechanical cams and linkages), punched paper tape, magnetic tape, magnetic disks, computer memory, or any of a variety of other media. It is common today for automated equipment to use computer storage technology as the means for storing the programmed commands and converting them into controlled actions. One of the advantages of computer storage is that the program can be readily changed or improved. Altering a program that is contained on mechanical cams involves considerable work.

Par. 3 – Programmable machines are often capable of making decisions during their operation. The **decision-making capacity** is contained in the control program in the form of logical instructions that govern the operation of such a system under different circumstances. There are several reasons for providing an automated system with decision-making capability, which has to include the following features:

Par. 4 – Error detection and recovery – Error detection and recovery is concerned with decisions that must be made by the system in response to undesirable operating conditions. In the operation of any automated system, malfunctions and errors sometimes occur during the normal cycle of operations, for which some form of corrective action must be taken to restore the system. The usual response to a system malfunction has been to call for human assistance. There is a growing trend in automation and robotics to enable the system itself to sense these malfunctions and to correct them in some manner without human intervention. This sensing and correction is referred to as error detection and recovery, and it requires that a decision-making capability be programmed into the system.

Par. 5 – Safety monitoring – Safety monitoring is a special case of error detection and recovery in which the malfunction involves a safety hazard. Decisions are required when the automated system sensors detect that a safety condition has developed that would be hazardous to the equipment or humans near the equipment. The purpose of the safety-monitoring system is to detect the hazard and to take the most appropriate action to remove or reduce it. This may involve stopping the operation and alerting maintenance personnel to the condition, or it may involve a more complex set of actions to eliminate the safety problem.

Par. 6 – Interaction with humans – Automated systems are usually required to interact with humans in some way. An automatic bank teller machine, for example, must receive instructions from customers and act accordingly. In some automated systems, a variety of different instructions from humans is possible, and the decision-making capability of the system must be quite sophisticated in order to deal with the array of possibilities.

Par. 7 – Process optimization – A fourth reason for decision making in an automated system is to optimize the process. The need for optimization occurs most commonly in processes in which there is an economic performance criterion and where optimization is desirable. For example, minimizing cost is usually an important objective in manufacturing. The automated system might use adaptive control to receive appropriate sensor signals and other inputs and make decisions to drive the process toward the optimal state.

2 *Ask and answer the following questions in turns.*

a. What is the function of the program?
b. What does the complexity of a program depend on?
c. How are program commands and feedback control linked?
d. Do all commands need a feedback?
e. How does a system respond to variations?
f. What is today commonly used for storing commands?
g. Why is decision-making capability important in automated systems?
h. What is the more recent trend in responding to system malfunction?
i. How can a safety-monitoring system act?
j. When is optimization mostly taken into consideration?

GLOSSARY

loop: ciclo.
to flip: azionare.
raw material: materia prima.
cam: camma.
decision making capacity/capability: capacità di prendere decisioni.
automatic bank teller machine (ATM): bancomat.