ROBOTICS AND AUTOMATION: CHALLENGES AND PROSPECTS FOR INDUSTRIAL PRODUCTION

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Since its inception, Earth civilization has been constantly striving to improve living conditions, increase human well-being, and peaceful coexistence. Their achievement is inextricably linked with the need to increase labor productivity, train qualified personnel, and the evolutionary processes of scientific and technological progress.

Nowadays, the work of any enterprise, including optical and electronic instrument-making, is unthinkable without the support of electronic digital information technologies of management and automated systems, starting from the technological level and ending with the level of strategy management for top managers. In modern conditions, there is an integration of automated systems related to a certain level, as well as vertically, of the management of an industrial enterprise, a manufacturing organization. It is accompanied by the formation of a single electronic information space (SIS) space, in which a virtual component of an organization, a manufacturing company, called a virtual enterprise, appears. Its functioning and interaction with the external environment is carried out by virtual agents (software robots) of different purposes and names. The creation of the SIS is based on the concept, principles and technologies of information technologies of descriptions of products, the production environment and processes that occur in this environment) CALS (Continuous Acquisition and Life cycle Support - continuous information support of the product life cycle) and agent-oriented virtual enterprises.

PLM solutions are associated with a model-oriented process of production preparation, manufacturing and assembly, often accompanied by the creation of digital models of production. The use of digital models is possible both at the stage of designing and debugging virtual production, and in real time for monitoring

processes and adjusting ongoing production processes.

A number of tasks in the production zone are solved using the functionality of manufacturing execution systems (MES systems), the functions and examples of which are discussed in the report.

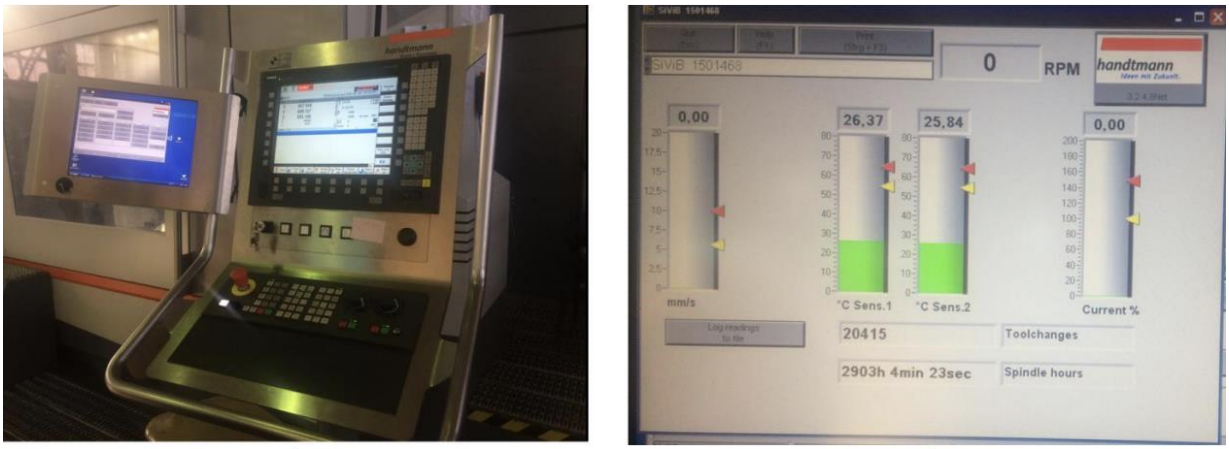
Production systems exchange information with automated systems of the technological zone. In the technological zone, various technological mechanisms, stationary and mobile machines, technological equipment are located, including those equipped with numerical control systems (NCS) and supported by the operation of an automated process control system (APCS).

а) б)

1-figure. PLM-management system TeamCenter of Siemens Industry Software division: a) classic representation of composition; b) representation oriented to support of technologies of systems engineering

For instrument-making enterprises, technological equipment is relevant that implements in an automated mode many technologies of casting, coating, marking, mechanical processing of various materials and allows automating the processes of manufacturing printed circuit boards, applying solder paste or glue to printed circuit boards, arranging elements on a printed circuit board, surface mounting and soldering, assembling printed circuit boards and products. At present, it is possible to develop and debug control programs in the instrumental 2D and 3D virtual environment of both CNC (Fig. 2) and on a personal computer. The report provides examples of such instrumental environments for various means of

technological equipment and notes their features.

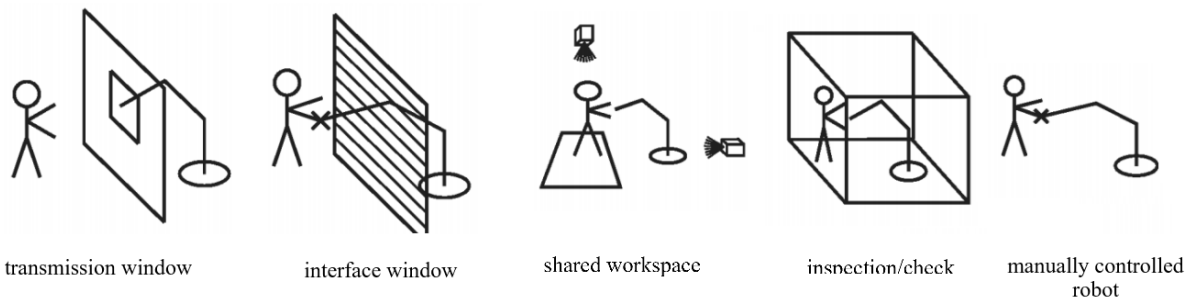


а) б)

2 - figure. Control panel of a metalworking machine with numerical control systems: a) with two panels; b) one of the operator-technologist's mnemonic diagrams

Industrial robots are developed and used to solve various industrial problems. Their use is also observed in instrument-making enterprises, in particular, in the form of robotic modules and robotic complexes that solve problems of mechanical processing of various materials, soldering, welding, painting, sorting, measuring, assembly and transportation.

In robotic complexes and robotic lines, robots can work autonomously, together with each other and in interaction with a person in the workspace (Fig. 3). The interaction of the operator with the robot is determined by its software and hardware input-output devices. Thus, interaction is possible using setting devices (for example, buttons, joysticks), sound (speech commands, sound signals), visual (gestures, facial expression recognition) and through cerebral interfaces (neurocomputer interface or brain-computer interface).



3 - figure. Examples of human-robot collaboration

In our country, industrial robots produced by foreign companies are mainly used, for example, Fanuc Robotics and KUKA Roboter GmbH. Each of them presents a wide range of robots for various applications (Fig. 4).

4 - figure. Industrial robots from Fanuc Robotics: a) fragment of the robot model range; b) intelligent portable control panel; c) system controller

The final part of the report provides a comparative analysis of the capabilities and demonstrates the feasibility of the widespread use of robots from various companies in robotic complexes of technological systems of industrial enterprises in the instrument-making industry.

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