

# The Development of Direction «Mechatronics and Robotics» in NTI (Branch) URFU

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## Abstract

At 2017 in NTI (branch) UrfU there was implemented the first graduate of baccalaureate school on «Mechatronics and robotics» direction. Developing of this new and difficult direction required pooling of efforts of several institute departments, professional development of teachers, application of new educational technologies, and also developing and modernization of laboratory base. There are considered ways of developing «Mechatronics and robotics» direction in Nizhniy Tagil technological institute UrfU in this report.

**Keywords:** mechatronics, robotics, project training, educational laboratory equipment, education.

At the beginning of training «Mechatronics and robotics» direction there was a number of educational laboratories, which could be used for teaching individual disciplines on this direction. But this laboratory equipment partially obsoleted, was located in different buildings and required of addition and joining to common conception of mechatronics.

As a result laboratory of hydraulics and pneumatics as the most modern and occupying place, was amended by electric drives, automatization system and industrial data network based on *Siemens*, which combined the available laboratory stands of different action principles into a single mechatronics system.

The use of laboratory in training students, and also students of advanced training courses and students professional retraining allowed to improve the quality of training of specialists in the field of industrial automation and mechatronics (Siemens controllers programming, industrial information networks, visualization systems, electric and hydraulic drives, etc.) In addition to students of the «mechatronics and robotics» direction students of the "Electrical engineering and power engineering" direction studied in the laboratory, "Design and technological support of machine-building productions», and also students of some technical specialties within General professional and special disciplines "Theory of automatic control", "electronics", "automation of production processes", "Management of technical systems", "electric Drive", etc. Also on the basis of the laboratory is partially implemented training on the project "New personnel for defense industry" and training in "System engineering" for Higher engineering school of UrfU.

As a result, the laboratory has stands with electric, hydro, pneumatic actuators, automation equipment (programmable logic controllers and peripherals), personal computers, combined industrial data networks (Profibus and Profinet). On fig.1 shown a typical training and laboratory stand based on programmable logic controller (PLC) S7-300. On fig.2 shown training and

laboratory stand for pneumatic actuator and pneumatic automation based on PLC S7-1200. On fig.3 shown the educational-laboratory stand based on Sinamics.

All PLC, personal computers and operator panels are connected by a single data network, that simplifies the interaction of the teacher and students, also makes it possible to study various industrial data transmission networks.

Also the laboratory has:

1. production mechanisms stands-simulators (rotary stand, distribution system, pump station, installation of electric heating, positioning system) equipped with PLC;
2. robotic designers based on Arduino microcontroller, where there are teaching practice and robotics for pupils lessons;
3. milling machine with Purelogic CNC;
4. virtual practical work that allows work remotely with real PLC using virtual control objects;
5. software package.



Figure 1. Stand on PLC S7-300 base



Figure 2. Stand on PLC S7-1200 base

There are world best practices of engineer education are used in learning process, first of all it is initiative CDIO (Conceive – Design – Implement – Operate), offered by Massachusetts technical institute (often called «project education»). More than 100 universities of the world participate in this project, including number of Russian universities, with the UrFU among them.



Figure 3. Stand based on electric drive *Sinamics*

General management of the process and the formulation of tasks are carried out by the teachers of departments, leaders of the educational programs as a direction leaders. If it is necessary, competent experts, consultants, employees of enterprises are attracted.

To unite efforts in various directions, the Institute forms a multi-profile Student Design Bureau, re- whose residents, under the guidance of curators and experts, are capable of work on the idea, develop project documentation, make the necessary calculations and ultimately bring the idea to real realization in the form of product, technology.

As projects are being released to the level of real development, participation in the programs of Agency of Strategic Initiatives (National Technological Initiative), the Fund for Promoting Innovation (events UMNIK, START, Commercialization) for the purpose of creating small innovation enterprises (MIP, spin-off companies with the participation of UrFU).

MIPs in this strategy along with large corporate customers are the generator of tasks for students' project work.

According to the results of the first issue in the direction of «Mechatronics and Robotics» we can confidently state that the efforts made have given result. For the majority of graduates, the final qualification work, named (WCR) is only an intermediate stage of extensive work on projects. On two themes of projects, support was received from Fund for Promoting Innovation (UMNIC program). This development Mechanotherapeutic devices for restoring limbs after injuries and treatment of children with cerebral palsy; robotic installation that could apply coatings with help of an electric-spark method in hard-to-reach places, for example in pipes. Also, within the framework of the WRC 2017, were developed laboratory stands for the study of positioning systems and machine tools electric drive, electric heating control systems, innovative installation for applying protective coatings to electrical contacts, with the productivity of the deposition process is tens of times higher than in the manual technology.

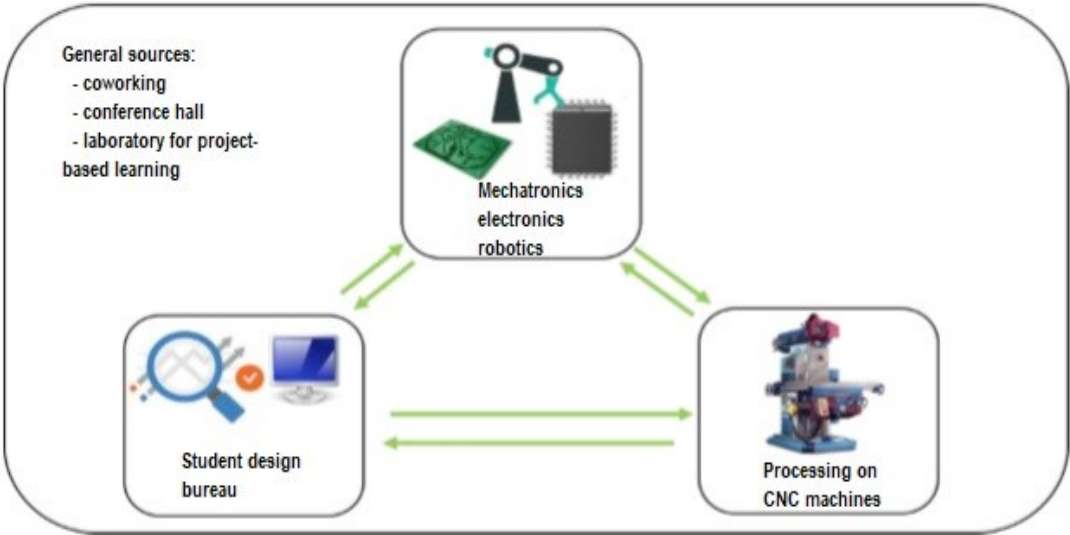


Figure 4. Scheme of interaction within the project training

In the future it is planned to deepen the content of the educational programs in the areas of artificial intelligence, machine learning, industrial robotics, system engineering. For development practical skills it was started preparation of teams from among students for performances at interuniversity championships *WorldSkills*. Also, a license for the educational program of magistracy has been received.

### **References**

1. <http://www.cdio.org/>