DEVELOPING **INDUSTRIAL ROBOT** USING POLYMERIC MATERIALS & ADAPTIVE SYSTEM CONTROL

EDiRO
Robotics Technologies

GENERAL INFORMATION:

- Studying and developing of an industrial robot-manipulator using polymeric materials and adaptive system control.
- Cybernation and payback from this robot will be a number of times faster than existing analogs.

MANY COMPANIES IN A LOT OF DEVELOPING COUNTRIES CANNOT AFFORD INDUSTRIAL ROBOTS, MAINLY BECAUSE OF TWO REASONS:

1. *— very high cost. Robots are very expensive.*
   The prices for import manipulators start at 35 000 Euro.

2. *— lack of professional specialists who can operate robots.*

Technology race today is a demanding fact which plays vast role in any companies' success and prosperity.

We build one of a kind welding robot made from polymeric materials.

Its cost is twice less that its foreign analogs, and it is a lot easier in operating and maintenance. We are able to keep the cost low because of these 2 factors:

1. ***We don't buy software, we build our own system.***

2. ***We use polymeric materials for carcass/body frame.***
   Its characteristics are close to metallic ones but much lighter in weight and cheaper in price. Because of that robots use reducing gears and that allows to lessen power usage.

TO KEEP ROBOT'S ASSEMBLY AND MAINTENANCE PLAIN AND SIMPLE, WE BUILD:

- Simple module construction. Industrial robot comes to a plant/factory unassembled. Instructions are simple so any worker can assemble the robot.
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- Adaptive control system which shifts part of programming duty into a robot: automatic calibration.

- Coordinative pointer for easy and fast trajectory task of a welding stitch.

- Welder's monitoring — collecting and saving all details of the welding parts in a library.
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- Special application to run/control robot from a data tablet. Regular tablet's availability and accessibility beats expensive remote controllers from abroad.

It saves company's time and finances.

MAIN TECHNOLOGICAL AND MARKETING TRENDS IN THE INDUSTRY:

- **Simplification.** Tech development that simplifies interaction between a man and a machine with minimum help from interface and voice command in the nearest future. Simplification of the assembly and repair due to module construction.
- **Sensitivity and independence of robots.** Development of artificial intelligence will help shift most of programming into robots.
- **Collaboration with people.** Using robots in tandem with people shows high efficiency. This way it is easy to rebuild or reprogram robots to be efficient within small businesses.
- **Digitalization of all robot-related industry.** Developing smart production/manufacturing connecting all systems. (Industry 4.0). Autonomic robots will work with each other and with the system. Managing such group or stand-alone robot will be possible from any device that is connected to the Internet.

TECHNOLOGY I

Pic. 1. — General view of the 6-shafted robot-manipulator construction.

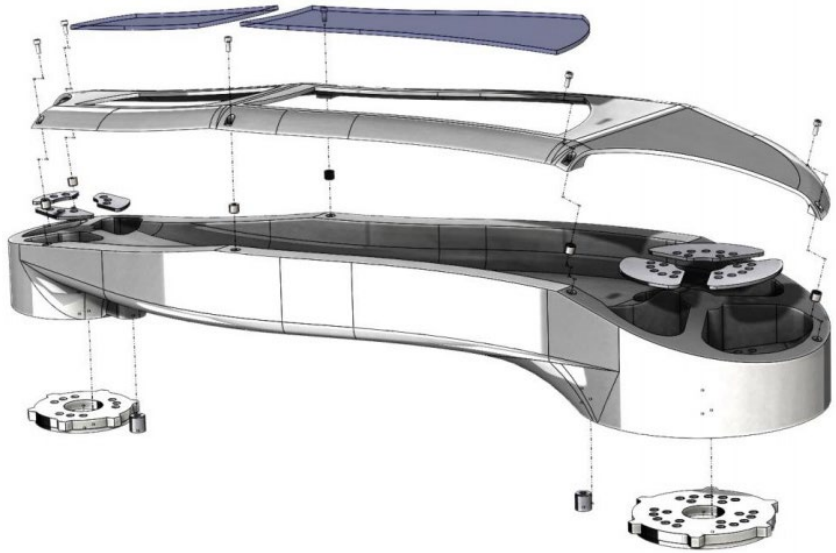
Robot's structure/mechanism.

The main principle of operation of this construction is a use of polymeric material on joints' bodies with pressed cage nuts where conjoined joints get the most pressure.

Pressed steel parts changed into polyamide ones with preheating process of the polyamide parts up to 80-90 C (176-194 F) degrees. Special construction guarantee strong conjunction of the parts.

TECHNOLOGY II

Robot's structure/mechanism.

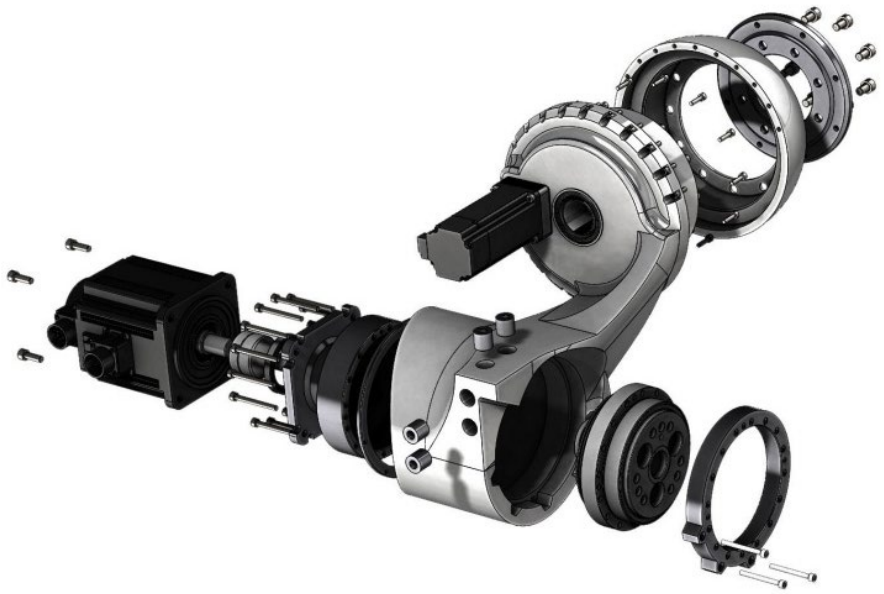


Pic. 2. — Pressing embedded elements and assembly of the second joint.

Main knots for the installation of steel embedded elements:

- conjunction knots of the joints
- reductions' installation
- intensive elements for additional hardness
- carving embedded elements for screw-bolt installation, etc.

TECHNOLOGY III



Pic. 3 — Pressing embedded elements and assembling of the third joint.

Robot's structure/mechanism.

Pressing embedded elements and assembling of the third joint.

This assembly allows to lower down the mass of robot's joints due to the much lighter polymeric materials used.

Polymeric is also resistant/sturdy material when it comes to the vibrating loads which allows to create more accurate manipulations with specific trajectories.

TECHNOLOGY IV

Pic. 4. — Cycloid gear (partly assembled).

Standard servos are used with absolute encoder.

Example — DELTA's servo (or servo of our own/Russian production)

ROBOT'S CHARACTERISTICS:

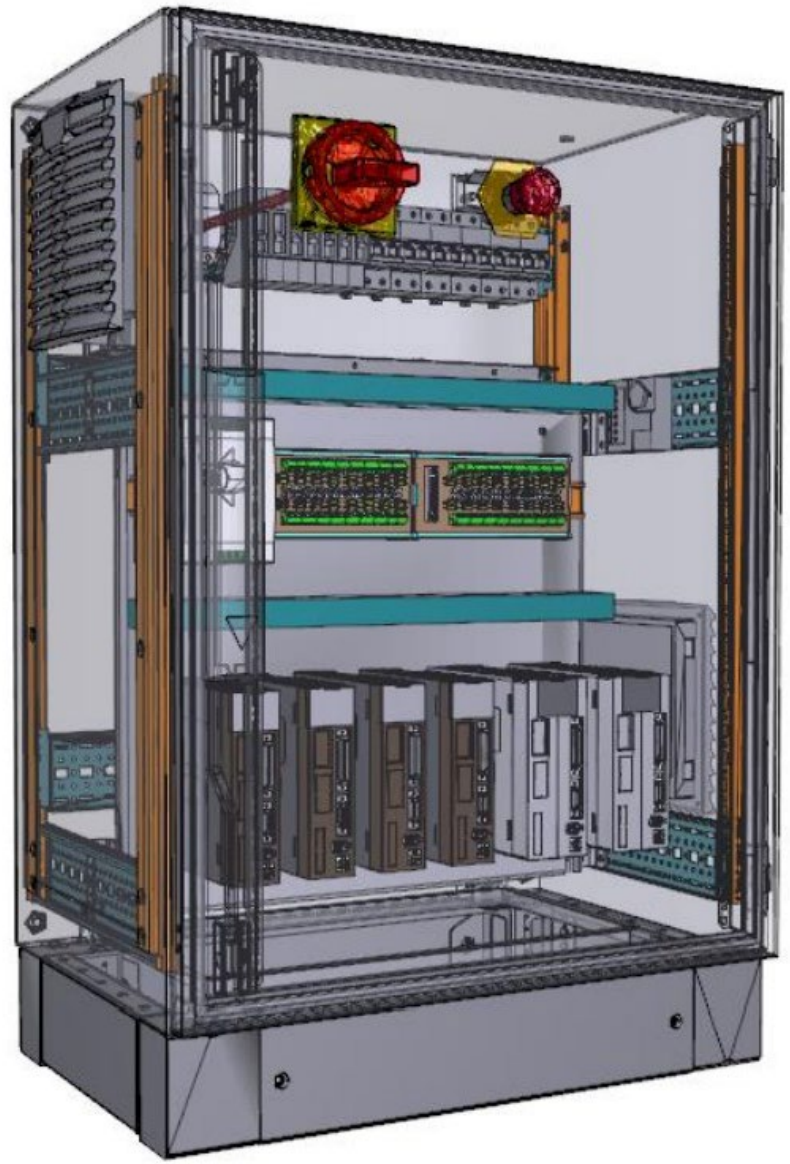
Weight	160 kg
Payload	10 kg
Repeatability	±0,1 mm
Range	2000 mm
Consuming power	2,0 кVт
Suggested working temp.	+10 +45°C
Freedom level	6 knuckle shafts

WORKING RANGE:

Shaft 1	-180°~+180°
Shaft 2	-105°~+155°
Shaft 3	-170°~+220°
Shaft 4	-150°~+150°
Shaft 5	-90°~+135°
Shaft 6	-210°~+210°

MAXIMUM SPEED:

Shaft 1	3,44 rad/c, 197°/c
Shaft 2	3,32 rad /c, 190°/c
Shaft 3	3,67 rad /c, 210°/c
Shaft 4	7,16 rad /c, 410°/c
Shaft 5	7,16 rad /c, 410°/c
Shaft 6	10,06 rad /c, 610°/c



ROBOT'S MECHATRONICS

Main functional parts of robot's controller and electrical scheme of controller have been developed. The controller's cabinet includes electronic schemes of power distribution chains, safety chains, control and managing chains for servo shafts 1-6, and chains for connecting industrial PC.

At this point all components are ready and the controller is at assembling stage. In the nearest future we'll be working on developing our own gear.

Today we are working on the software development for adaptive technologies to control robots, such as:

- ***Coordinative pointer.*** *Development of this product will help building a welding trajectory for robots.*
- ***Welding monitoring.*** *Developing of a program which will collect welding parts' data. Every details (all info) will be stored in a special library where it can be retrieved at will for future projects.*
- ***Welding resources Library.*** *Development of a special app containing a library with all welding projects used and stored.*
- ***Interaction with 3D models.*** *Developing of a special app where you can download a 3D model with welding points. Using 3D vision system robots can generate actual coordinates and build welding trajectory. Using this technique, an automatic welding regimen can be saved for repeated projects.*

RESOURCES

Project's history and dynamics

Initially, we are systems integrators of industrial robots. We work on projects with different levels of complexity — from a simple cell to a complete robot-operated manufactory. Automotive lines, control systems, info-systems for monitoring and document flow of the equipment, and also non-standard solutions and equipment — furniture/rigging, shelf-mechanics, positioners, linear modules, lateral and ring welding machine.

We've worked with all famous robotic brands — KUKA, FANUC, YASKAWA, NACHI, Kawasaki, ABB, Panasonic — we've learnt their particular qualities, weak and strong sides.

After getting enough knowledge and experience in programming and developing robots, we've started working on our own developing of a 6-shifted manipulator.

PLAN FOR THE NEXT DEVELOPMENT

Today we produce the most popular model of industrial robot – 10 kg load capacity/2000 mm reachability for welding and cutting.

During next few years we'll be perfecting the adaptive control system making robots more autonomous. In 2019 we're planning to widen the line of robots increasing its load capacity: models with 50, 120 and 210 kg. load capacity. Also, in talks is a line of robots for electronic industry, robotic mobile platforms, ready cells based on robots, and other solutions for the industries.