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DIDACTIC MODELS OF MANIPULATORS

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Abstract: The paper deals with experimental model designed for educational purposes. These educational models support the creativity and innovation thinking of students. Both designed models are as compact model, but they enables completely rebuilding by students also students can add new units for extending of possibilities of these model.

1 Introduction

Mechatronics is interdisciplinary field which integrates mechanics, electronics and intelligent control. Mechatronic product is developed with aim to obtain improved properties or totally new functions are added. There are two ways for mechatronic product developing. First way is to improve already existing products, which have been before in mechanical form or electromechanical form. Second way is to develop completely new products, which have not been before.

Developing of mechatronic, products require synergy integration of knowledge from various areas as mechanics, electronics, control system, pneumatics, hydraulics, optics, thermomechanics, precision engineering, etc. Developing of successful mechatronic products needs optimal combination of all related areas.

Educational activities in mechatronic need practical experimental models of mechatronic products. Students can make any experiments and generate innovation ideas for improving of mechatronic products [2-10].

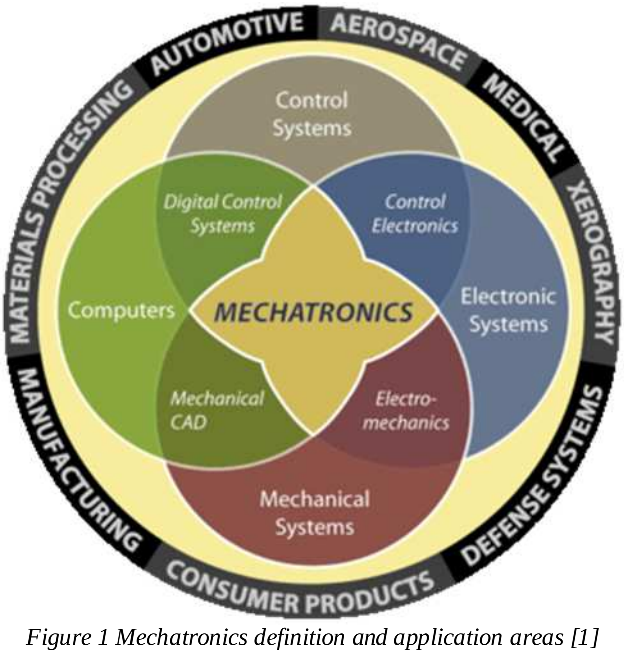

Figure 1 Mechatronics definition and application areas [1]

The main aim of this paper is present designed didactic models suitable for educational in mechatronics.

2 Joint manipulator

The aim was to develop manipulator, which will be useful for experiments, but also allows to modify and change the solution, add new functions and include innovations. Joint manipulator has 4 degree of freedom. Base of the manipulator can rotate to full rotation (360°). Every joint actuator allows to rotate in range ±90°. All construction of manipulator is designed as fully demountable and it is possible to build new modified model with new parameters. The variability of design was the first important aim. There is a bigger place for creativity of student. Also students can design totally new parts and subsystems for adding of new functionality to manipulator. The manipulator is controlled by the using of microcontroller, which is as small control unit for control of all actuators integrated in manipulator.

Figure 2 3D model of the manipulator

Position servomechanisms have been used as actuator in every joint of manipulator. These servomechanisms are simple and compact units, which can be controlled through the pulse width modulated signal from microcontroller. Printed circuit board is designed as user friendly solution with protection against the wrong connection of any devices to board. The boards also allows variability of electrical connection and students can make modification or also can include the new innovative ideas.

3D model of manipulator has been developed for making the simulations of manipulator movements. These simulations give results from movement and it is necessary to know about the possibility of movement conflict between the parts of the manipulator.

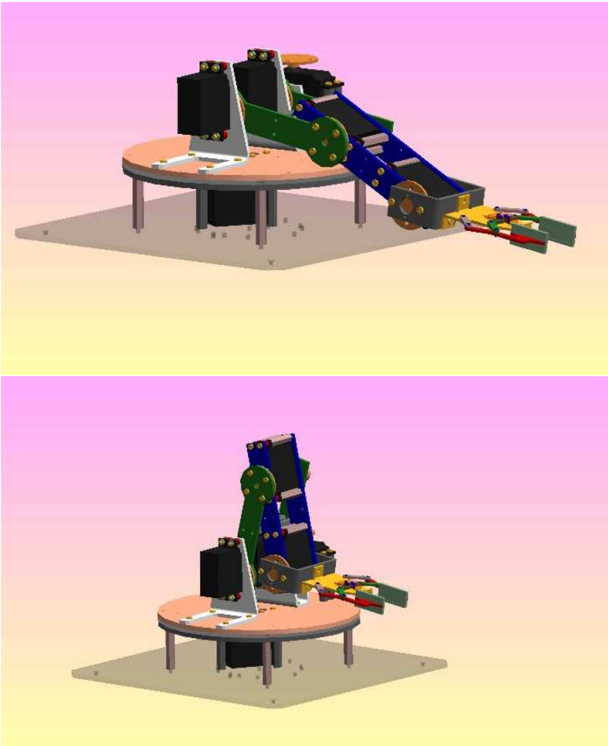

Figure 3 Kinematic simulations

Manipulator includes end-effector uses kinematic mechanism parallelogram for handling with any object. End-effector is able to hold cuboidal objects with maximum dimension 35 mm. It is designed as plane mechanism with parallel contact planes. Motion of the end-effector is realized via using of position servomechanism. Contact planes also includes tactile switch for recognition of object holding.

3 Cartesian manipulator

Next designed manipulator has cartesian kinematics (fig. 5) with independent movements in X, Y and Z axis. All axis is actuated with servomechanisms with belt transmission systems as transformation units for change of rotation motion to linear motion. These belt system have to be preloaded and suitable preloading mechanism should be placed in the manipulator (fig. 6).

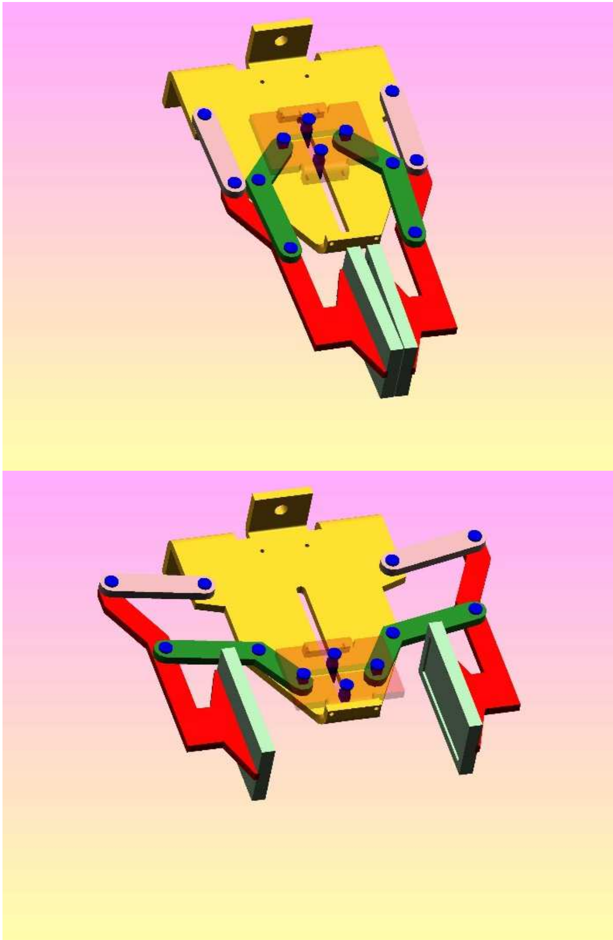

Figure 4 Design and simulation of end-effector

Unique design of this cartesian manipulator lies on principle that it is built on two beams. All movements are sensed with resistive position sensor. Information about all position are acquired into control unit for feedback controlling. Workplace of this manipulator is defined as cuboid. System enables to execute simultaneous movements in all axes.

4 Didactic aims

During the educational process it is important for students to absorb the theoretical knowledge earned during the lectures and then to realize it practically in the laboratories. The level of the presented absorption of the knowledge depends, to a great extent, on realized cognitive methods and utilized didactic tools. The proposed didactic model is supporting the applied educational approach by solving the defined problem situation. This approach, first of all, applies the problem interpretation-method and heuristic and the research methods. The problem solving philosophy of the education is based on the fact that during the problem task solving and the same by the model situation problem solving processes the students are acquiring the experience from their creative activity and they are creatively mastering their knowledge and the ways of their activity.

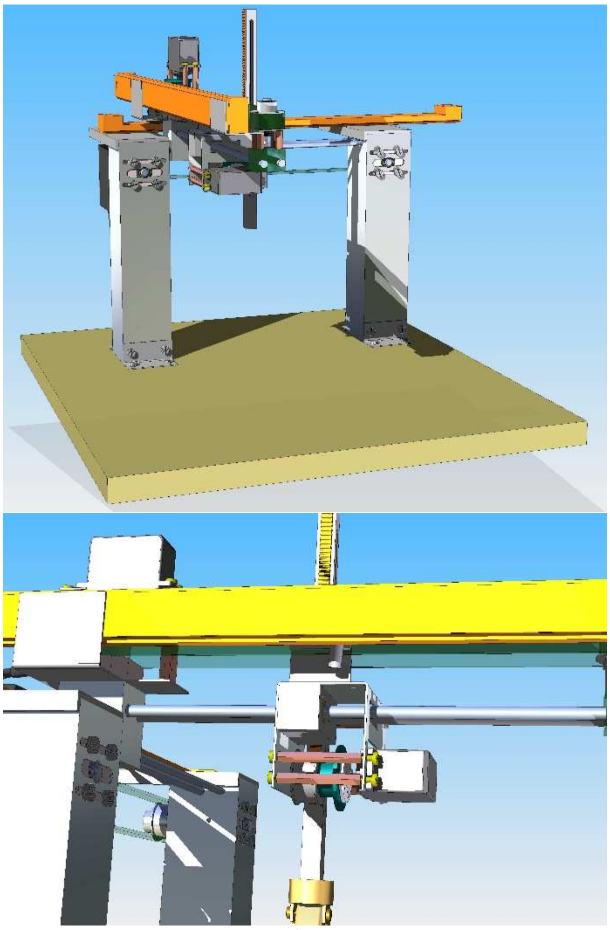

Figure 5 Design of cartesian manipulator

The students are joining the problem searching and problem solving processes through the activities of the teacher. This way the students are learning how to earn the new knowledge independently, they are applying their earlier acquired knowledge, and along with it they are personally experienced from their creative activities. The practical realization of the task and the personal involvement in problem solving are imitating the teamwork and the individuals may be aware of their importance within it. This approach is also of psychological and social natures both for the individual person and for the realization team.

The creative thinking rises during the problem solving situation when the student collides with an obstruction, some difficulty in his activity, some conflict if he impacts something unknown and uneasy and surprising and incomprehensible, whereas he does not know the way of overcoming the problem or the obstruction and he cannot solve it on the basis of his actual knowledge. In other words, the mechatronics is not only about the lectures and it has to pass to the students´ hands. So that the hands may act, they are directed by the brain. The brain has to think what directive to get out and what activities will be performed by the hands. If something is coming to the student's hands really, it means the integral chain of consideration and researching and the individual study and consultations among the team members and with the pedagogue who is both the guardian and the anchorman of the entire project. In this manner, the students are learning the philosophy of the mechatronics approach to the project of the products. Their, both the thinking and the creativity, are getting a new dimensions enabling the student's capability to get under better control the problem situations solving in the practice. Moreover, these manner-trained graduates markedly increase the probability of their practice. The same they may to fortify the competitiveness of their employers.

The design of the architecture of the model is modular and thus enabling an operative alteration of both the hardware and the software configurations.

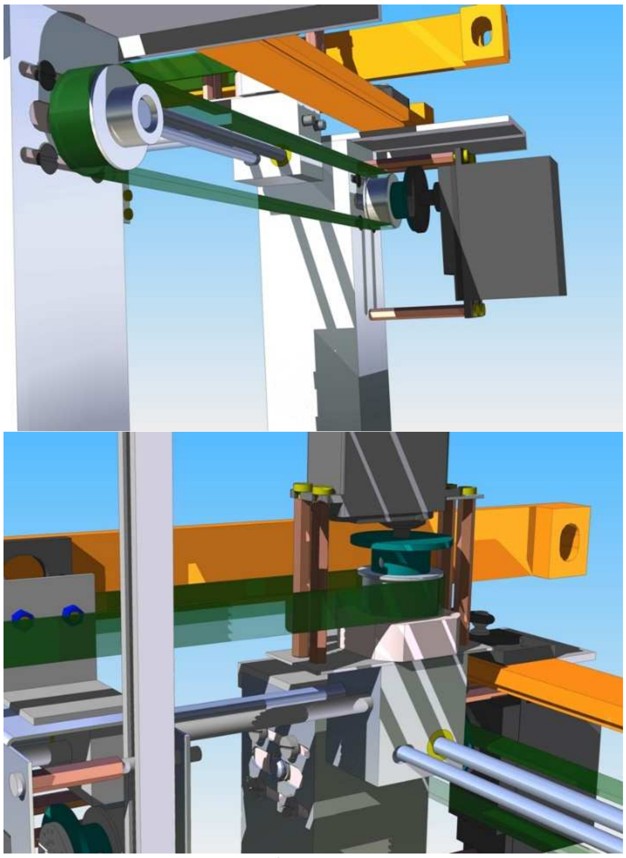

Figure 6 Drives for cartesian manipulator

5 Conclusion

Practical experiences can be obtained only when students will make a training on practical real models. Mentioned models have been built as compact systems, but it enables to modify any segments and units and students also can include any innovations into model. All works can be managed as team work and everything is made for properties improvements. [4-30].

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