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CELL DESIGN FOR GEARBOX ASSEMBLY

Urgency of the research. *Automation is the next step in increasing productivity and performance. It represents the autonomous management of the entire system as well as the assembly or production process. This completely eliminates a human factor from the work process.*

Target setting. *Today's robots and manipulators are now autonomous. Automated systems can be found in almost all industries. They are an indispensable part of non-productive environments, but we can also find them in non-industrial areas as well. Their dynamic development extends to service robotics. For their productivity, they have reached a high level, but their development is constantly advancing by refining their subsystems, introducing new functional principles, or upgrading components and elements involved in the construction of these mechanisms.*

Actual scientific researches and issues analysis. *To meet the requirements of automatition cells, it was slowly being applied to flexible production systems. These are systems that consist of computers and are connected by means of control units. They are characterized by complexity, flexibility and, above all, the multiplicity of elements. Such flexible systems based on the modularity, that systems are composed of individual modules and subsystems that can be adapted as needed.*

Uninvestigated parts of general issues defining. *Design of automated robotic workplaces, based on the intensive development of functional and especially kinematic structures of the workplace as a whole.*

The research objective. *To what extent is it possible for the work process to be mechanized or automated depends also on the level of development of the used equipment. In today's development stage, design of automated device is also automated.*

The statement of basic materials. *This article focuses on the design of the manipulator, whose main task is to perform the assembly. Analysis of the task illustrates the principle design of the solution, which is also the starting point for the design of the universal manipulator. Current requirements of application practice for robotic technology have caused increased requirements for its functions, characteristics and parameters which cannot be always covered by the traditional approach to its design and construction.*

Conclusions. *In this article describes in more detail the knowledge and division of the proposed devices and mechanisms, which provides an initial understanding of design. By analyzing the problem and defining the necessary parameters, the design of the manipulator was developed. Festo's design software also helped to make the right choice.*

Keywords: *manipulator; actuator; assembly; robotics; production cell.*
Fig.: 4. References: 9.

Introduction. Incorporating new technologies, more efficient manufacturing machines and industry innovations, it is expected to increase labor productivity and possibly exclude human power from the production process. So we can talk about mechanization and automation of production processes.

In particular, mechanization is a substitute for man, that is to say the replacement of human power with the help of engines, which also brings us increased performance and productivity. Still, it remains to solve the issue of mechanization of workpiece clamping, supply of containers, transportation of semi-finished products [1; 3].

With deeper insights into the application of these mechanisms and their requirements, we can say that applications that can and are capable of performing robotic devices are now almost unlimited. However, these applications must meet the requirements for process quality and stability. Quality has not only an effect on the quality of the output element, but also on energy, material and time consumption [4; 6; 8].

Modular assembly systems are, from the point of view of the technical solution, compiled from:

- Flexible technology modules - Module capable of technologically covering the specified range of products, simple reconfiguration of module elements to cover a related assortment of products.
- Modular builders of the decisive elements of the production system - a manual reconfiguration of these elements (within the scope of the construction kit), elements with new properties and parameters can be assembled [2; 7; 9].

These approaches bring in the design of automated robotic workplaces a new direction based on the intensive development of functional but especially kinematic structures of the workplace as a whole.

Automationa design of manipulator for assembly. For each proposal (new design of manipulator), it is important to follow a certain hierarchy and continuity between the mechanisms. The reason is the continuity of parameters between applied devices. The procedure

I chose for is fast and proven on several manipulators created. The design process is as follows. As an example, I present a manipulator design for the assembly of plastic gearbox. First step is choose kinematics of manipulator [4; 8].

Kinematics: A manipulator containing from 3 translational movements in the x, y, z direction is suitable for assembly. All these movements are provided by electric stepper motors to achieve the exact position of the manipulator.

Workspace: manipulator drives together perform movements that describe the shape of the cube. Its definition is shown in Figure 1.

In the case of a manipulator design, I opted for portal architecture because it is a more expensive option, but due to its flexibility and usability in the future, in my opinion, it is a more advantageous variant. The size of the workspace is directly determined by the stroke sizes of the individual drives.

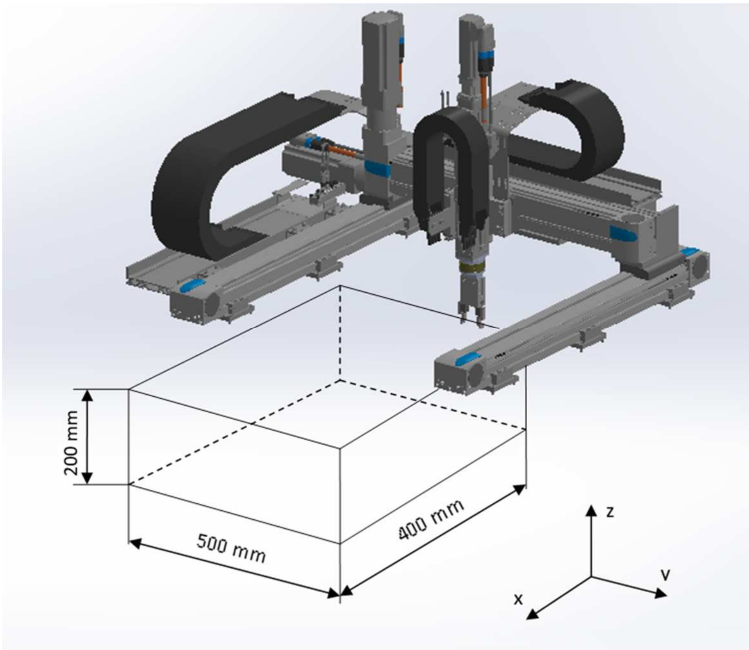

Fig. 1. Workspace of manipulator

Design of actuators: All calculations of the drives I realized using the Festo design software, which made it easy and convenient to select the most suitable type of manipulator for my case:

1. Axis definition and payload:

Drive type: X: Electric, multiple positions
Z: Electric, multiple positions
Y: Electric, multiple positions

Required workspace: X: 500 mm
Y: 400 mm
Z: 200 mm

Useful load (efector and workpiece): 0.356 kg

Distance of center of gravity: X: 19 mm
Y: 19 mm
Z: 3 mm

2. Reference cycle and system dimensioning:

- Traveling distance S = 300mm
- Number of changes i = 4
- Duration: 5 s

- Snap time and waiting time: 2 s
- Cycle time: 7 s
- Additional force in Z direction in 1a 2: 15 N

3. Selection of electrical properties:

- Engine position on X axis: left
- Safety function of the motor controller according to EN 61800-5-2: Basic STO
- Bus connection: I / O operation or integrated

4. System Configuration:

- Engine type: Festo engine
- Engine brake: X: no
  Y: no
  Z: yes
- Controller Type: Festa Engine Controller
- Engine driver for X, Y, Z: CMMP-AS-M0
- Festo Sensor Kit
- Switching output: PNP
- Switching function for electric axes: Switch
- Fixing: Profile fastening
- Minimum lead length from the output of the power chain: 5 m
- Mounting type: Complete mounting

Results of the calculations of individual axes

Using Festo's Positioning Drives 2.3.14, designed for electric drives, we can generate work cycles, including single axle loads.

For axis x, Fig. 2 we can read the following:

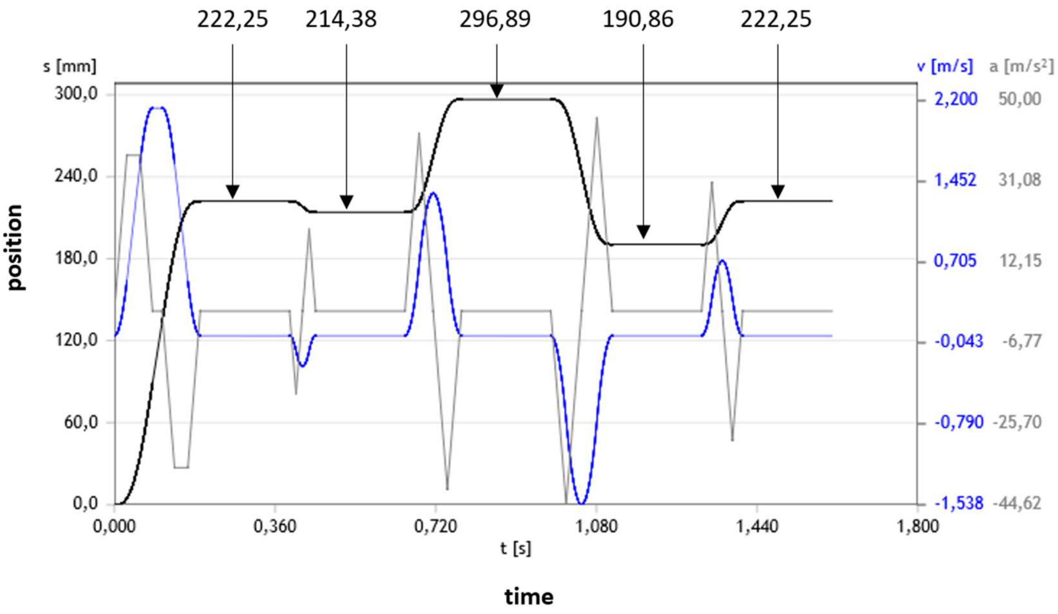

Fig. 2. Process diagram of axis X

A value of 214.38 mm - rearward displacement of 8.12 mm to the required position of the gear in the actuator.

The value of 296.89 mm - is moved forward by 82.51 mm above the vibratory gearbox with the gear wheel D_a = 38 mm.

A value of 190.86 mm - a rearward displacement of 106.03 to the required position of the gear in the actuator.

222.25 mm - return to the original position.

Modul Y

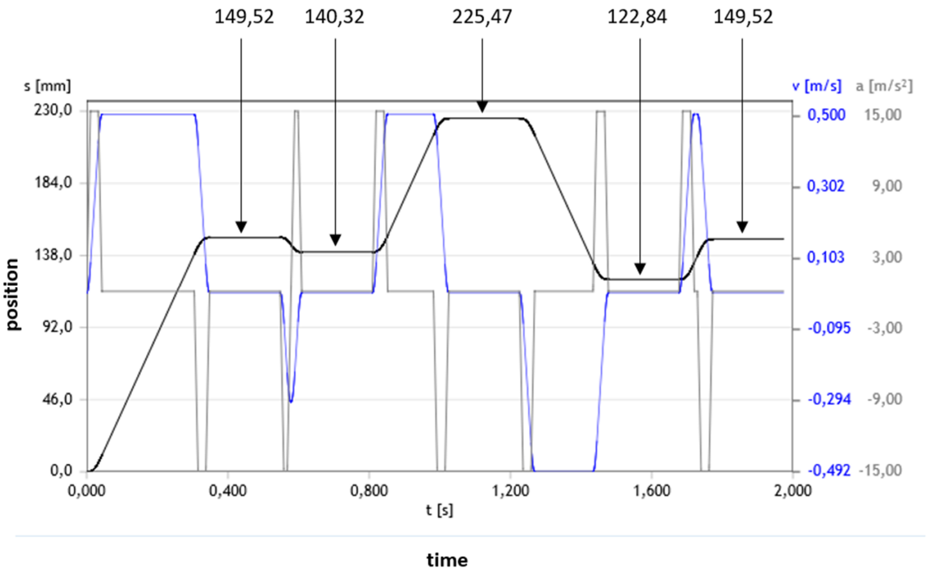

Fig. 3. Process diagram of axis Y

149.52 mm - position of the module above the vibratory gearbox with the gear wheel d_a = 29 mm.

140.32 mm - Moving the module backward by 9.20 mm to the required position of the gear in the actuator.

225,47 mm - the module moves forward by 85,15 mm above the vibratory gearbox with a sprocket of diameter D_a = 38 mm.

122.84 mm - module rearward displacement by 102.63 mm to the required position of the gear in the actuator

The value of 149.52 mm - the initial position.

Modul Z

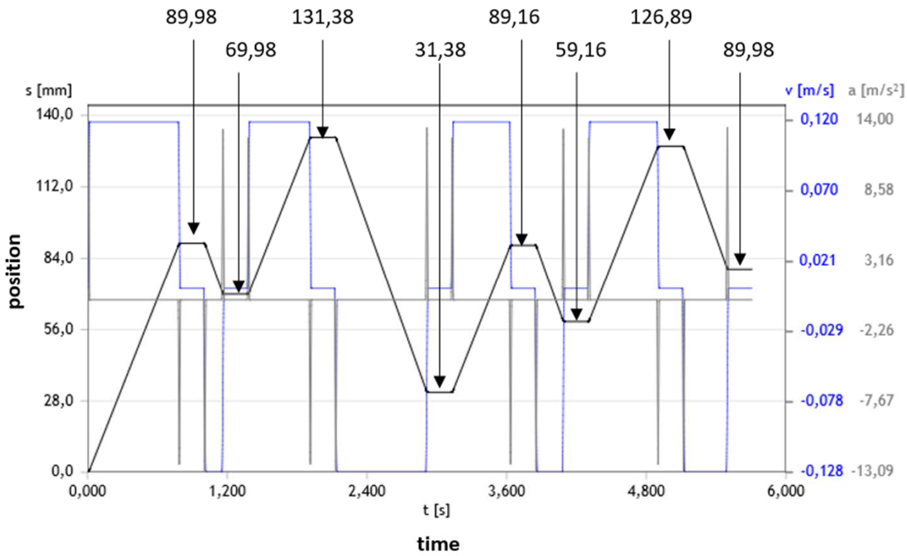

Fig. 4. Process diagram of axis Z

The value of 89.98 mm - transfer to the gripping height of the gear d_a = 29 mm from the vibratory container.

69.98 mm - Module stroke by 20 mm with already gripped gear.

The value of 131.38 mm - a decrease of 61.4 mm to the height of application of the actuator tooth.

31.38 mm - The module is lifted 100 mm above the vibrating tray.

89.16 mm - the module slides by 57.78 mm to the gearing position D_a = 38 mm.

The value of 59.16 mm - a lift of 30 mm with the already gripped gear.

The value of 126.89 mm - a displacement of 68.73 mm to the position of the gearing

89.98 mm - return to the initial position

Conclusion

First, it describes and describes in more detail the knowledge and division of the proposed devices and mechanisms, which also provides us with an initial excursion by design. By analyzing the problem and defining the necessary parameters, we came to the design of the manipulator itself. Festo's design software also helped us to make the right choice.

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ПРОЕКТУВАННЯ МОДУЛЯ ДЛЯ СКЛАДАННЯ КОРОБКИ ПЕРЕДАЧ

Актуальність теми дослідження. *Автоматизація – це наступний крок у підвищенні продуктивності та ефективності. Вона являє собою автономне управління цілою системою, а також процесами складання та виготовлення, що повністю усуває людський фактор від робочого процесу.*

Постановка проблеми. *Сьогодні роботи та маніпулятори є автономними. Автоматизовані системи зустрічаються практично в усіх галузях промисловості. Вони є необхідною частиною виробничого обладнання, однак їх також можна знайти в непромислових сферах. Їхній динамічний розвиток розповсюджується і на сервісну робототехніку. Щодо своєї продуктивності, вони досягли високого рівня, але їхній розвиток постійно розширюється шляхом вдосконалення їх підсистем, впровадження нових функціональних принципів або модернізації компонентів і елементів, що використовуються в конструкції таких механізмів.*

Аналіз останніх досліджень і публікацій. *Щоб задовольнити вимоги автоматизованих модулів, вони поступово вводилися в гнучкі виробничі системи. Це системи, що складаються з комп'ютерів і з'єднані за допомогою блоків керування. Вони характеризуються складністю, гнучкістю і передусім множинністю елементів. Такі гнучкі системи базуються на модульності та складаються з окремих модулів та підсистем, які можуть бути адаптовані за потребою.*

Виділення недосліджених частин загальної проблеми. *Проектування автоматизованих роботизованих робочих місць, засноване на інтенсивному розвитку функціональних і особливо кінематичних структур робочого місця загалом.*

Постановка завдання. *До якого рівня можлива механізація чи автоматизація робочого процесу, залежить також і від рівня розвитку використовуваного обладнання. На сучасній стадії розвитку проектування автоматичного пристрою також є автоматизованим.*

Виклад основного матеріалу. *Стаття сфокусована на проектуванні маніпулятора, основним завданням якого є виконати складання. Аналіз завдання ілюструє принципову модель рішення, що також є відправною точкою для розробки універсального маніпулятора. Поточні вимоги практичного застосування роботизованих технологій викликали підвищені вимоги до їхніх функцій, характеристик і параметрів, які не завжди можна охопити традиційним підходом до їх проектування та конструювання.*

Висновки відповідно до статті. *У цій статті більш детально описані знання і розподіл запропонованих пристроїв і механізмів, що забезпечує початкове розуміння конструкції. Аналізуючи проблему і визначаючи необхідні параметри, була розроблена конструкція маніпулятора. Програмне забезпечення дизайну Festo також допомогло зробити правильний вибір.*

Ключові слова: *маніпулятор; привод; складання; робототехніка; виробничий модуль.*

Рис.: 4. Бібл.: 9.

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