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ROBOTIZED WORKPLACE FOR PICK AND PLACE OPERATION IN SIMULATION PROGRAM ROBOTSTUDIO

The aim of the article is to acquaint the proposal for a robotized workplace to sort the SM072 and SM155 servo motor. This workplace is designed and programmed in RobotStudio simulation environment. This program is from ABB and serves for offline programming of industrial robots. The article deals with the complete design of the workplace and parts thereof in this simulation environment. These are individual parts of the workplace, the creation procedure and the overall design of the industrial robot workplace. The article is a publication of scientific and methodical character.

Keywords: *robotized workplace; pick and place; simulation; SmartComponents; RobotStudio; offline programming.*
Fig.: 5. References: 10.

Urgency of the research. For the 21st century, it is characterized by large development of modern technologies. Industrial robots are associated with the main aspect of automation and robotization in production processes. Industrial robots are currently the main element of robotized workplaces. These devices facilitate people work while improving not only the quality of production, but also the accuracy of technology or manipulation. The concept of a robotized workplace can imagine production line with elements as a conveyor belt, vibration tray, etc. But a basic device for creating a workplace is a robot. There are currently many types of industrial robots of different kinematic structures. We know many kinematic structures, but the most used are serial and parallel. Both these structures have advantages but also disadvantages. Robotization progresses and therefore represents a different stage in the workplaces where the robot needs to be installed e.g., due to monotonous activity. Therefore, robots are appeared on the market that cooperate with man.

Target setting. The article deals with the simulation environment from ABB - RobotStudio. The role of research was to design robotized workplace and implement the knowledge in the simulation software RobotStudio. In the next section, the elements that were used in the workplace is used in simulation environments are closer. As the work deals with the simulation environment was also necessary to describe this program. In the last section, a robotized workplace in the RobotStudio simulation environment has been proposed. This proposal constituted a selection of station, subsequent insertion of components from the library and inserting the created components from other sources. We created Layout of this workplace at the end. In this section, we focused on programming individual parts of the workplace by SmartComponents and a subsequent demo of the simulation and operation of the workplace.

Actual scientific researches and issues analysis. In the publications [1, 2], the theoretical displacement of the RobotStudio simulation environment is described.

Using RobotStudio software is performed offline, a robot work program in a short time that has been achieved online testing reducing the cost and development of technological design. ARC Program Virtual Appearance in RobotStudio allows to perform a detailed view of the data sheet that appears and creating weld material inside and eliminate errors. The economic application will be completed as needed, depending on the number of costs of pieces over operators, etc. At the end of the right, the results of the calculation of robotics and costs of a company that manufactures a welded assembly are shown [2].

The industrial market increases competitive pressure. Higher production efficiency is needed to reduce costs and increase quality. Allowing the robot programming adding time to beginning new products today is unacceptable because it turns off on progress to programming new or modified parts. Testing the risk of production tool and lamps without first reach verification and accessibility is no longer possible. Modern production site will verify the manufacturer of new parts during the design phase. When programming robots offline, it can be performed in parallel with the system. By programming the system at the same time as

manufacturing, the last can start earlier, reducing time to market. Offline programming reduces systemic risk by visualization and confirmation of solutions and layout before installing a real robot and creates a higher quality of the part through the creation of a more precise way. RobotStudio is an engineering tool for configuring and programming robots ABB, both real robots on the floor and virtual robots in the PC. To achieve true offline programming, RobotStudio uses ABB Virtual robot technology. In this project, it is presented how to create, program and simulate robotic cells and stations using RobotStudio and to supervise, install, configure and program Real Robot Controller and make mounting in RobotStudio using two robots and rotary conveyor. Parts are imported from Solidworks. This project is the simulation of RobotStudio software and can be performed in the mechatronics lab [3].

This publication is focused on imports of CAD models to create robotic workstations using offline programming. The principles of the engineering drawing in 2D and 3D creature with a fixed model needs to be respected. Upon successful creation of 3D model, you need to follow the import procedure to avoid detection of edges and surfaces used as CAD models. For this purpose, supporting CAD serves programs that can convert between them a wide range of 3D models of different formats. Created ABB robot programs in RobotStudio are a comprehensive series of sequential steps that cannot be accelerated. Creating goals and then paths are the best way to be used in the offline programming methods. If the correct procedure is reached, the functional simulation of future work will be easier throughout the entire robotic workstation, CAD models and integrated peripherals that cooperate with each other. The correct functional program created by programming offline will allow us to optimize the overall arrangement of the workplace, improving work efficiency, removing the collision states, etc. The program that is finally created is more-less usable in real environments using a minimum interference [4].

Uninvestigated parts of general matters defining. Based on the analysis of multiple publications, it is possible to conclude from an important step itself the addition of 3D objects in the simulation environment. RobotStudio is designed for offline programming robots from ABB. They are an important part of the so-called plugins. Plugins provide work e.g., with IRB 360 parallel robot - PowerPac. Another very important part is SmartComponent. Most frequently used are e.g., Sensors (LineSensor, PlaneSensor), Actions (Attacher, Detacher, Source), Manipulators (LinearMover, Rotator) etc.

The research objective. The article objective is to create a draft robotized workplace for sorting servo motors. RobotStudio software was used to create workplace simulation. Data from other resources was imported into the environment, but the main element was used from the library - the robot IRB 1660ID. To start the final simulation, it is necessary to work with SmartComponents.

The statement of basic materials. Offline programming is a method, which allows not working directly at the workplace. ABB Software is used for simulations and offline programming, RobotStudio, enables programming robots on PC in the office without turning off production.

RobotStudio provides tools to increase the profitability of the robotic system by permitting the tasks such as training, programming and optimization without interfering with production, providing several benefits:

- risk reduction,
- faster start,
- shorter switching,
- increased productivity.

RobotStudio is built on the management principle using ABB VirtualController, a copy of the actual software that drives robots in production. As a result, we can create realistic simulations using real robotic programs and configuration files as actually [5]. Fig. 1 shows an ABB RobotStudio simulation environment interface.

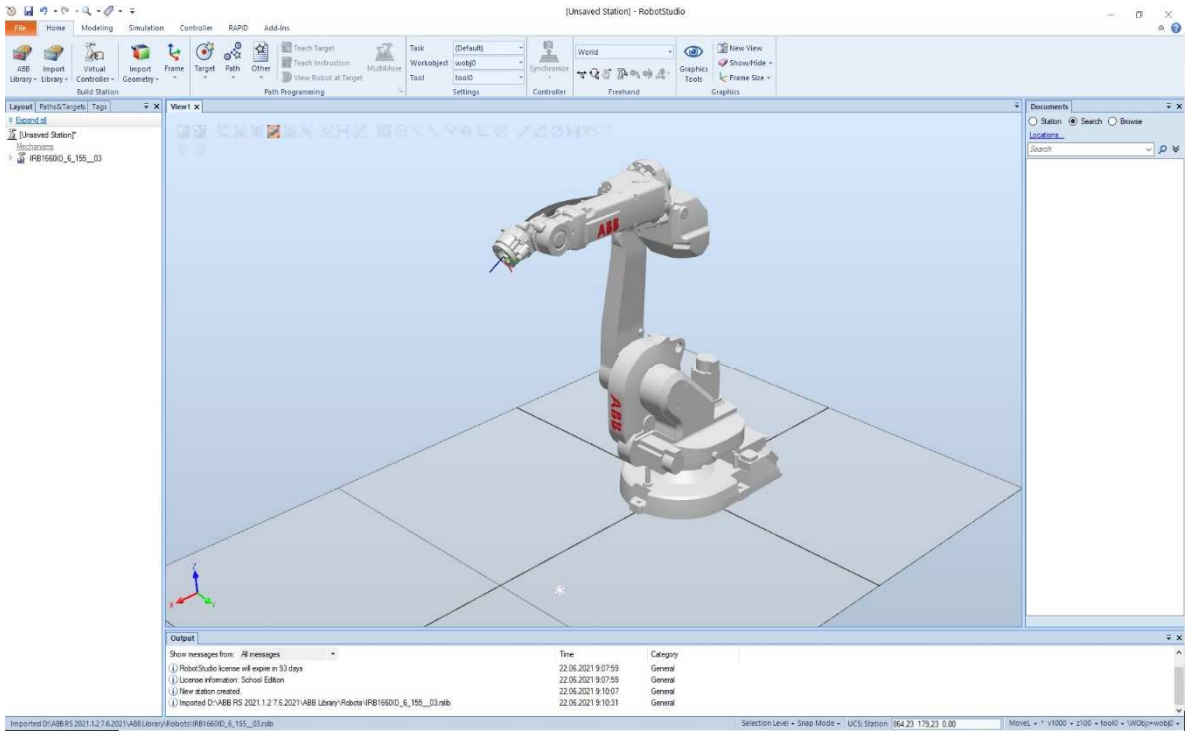

Fig. 1. Basic workplace with robot IRB 1660ID

In this section we will describe the creation of a robotized workplace to sort the SM072 and SM155 servo motors. We will describe the procedure for introducing individual components, which the robotized workplace consists of. Furthermore, we focus on Layout workplace and description of individual components. After inserting a robot from the program library, you need to select RobotWare version. In this case, 6.11.02 with the IRB 1660ID robot. There are multiple options to start this program. It depends on what type of workplace will be created. We used Solution with station and virtual controller. If we would like to create more complex workplaces, we need to use Empty station option to record a virtual controller into multiple robots or other mechanisms - linear unit or positioner [6].

Not all components we used to create robotized workplace are stored in the library we can find in RobotStudio. Some components created by SolidWorks or Creo, model that we have saved Step. The .step format is best suited for inserting custom components in RobotStudio simulation environment. Another well-used format is .sat, which also used [7].

The last created component is the vacuum effector we were branded in CAD program Creo. Will serve to grasp the servomotors using a vacuum. We had to decide between the vacuum and mechanical effector where we preferred a vacuum effector, therefore, because the mechanical effector could be damaged when gripping the servo. The unfolded effector can be seen at Fig. 2.

As we created this effector ourselves, it was necessary to create a Tool in RobotStudio. We will create a coordinate system (Frame) at the end, and a tool. The tool created has both its advantages and disadvantages. If the imported effector from the library should be used, all these data are already included, but the library do not contain the necessary end effector, therefore the possibility of creating one is chosen [8].

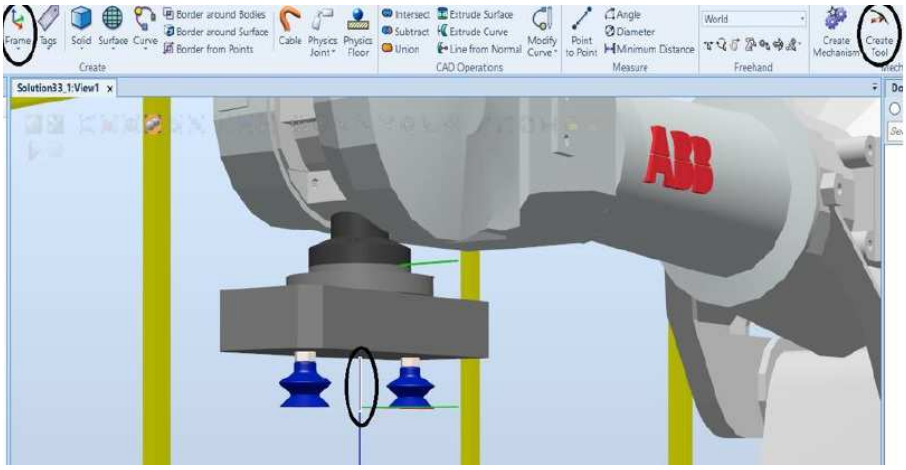

Fig. 2. Tool

The vacuum effector variant to be modelled, required this programming using SmartComponent. After adding, click Design and in the Inputs, you need to create a signal that we call Di_attach. Fig. 3 shows the creation of this signal. Creating is often quite demanding and comprehensive, which causes difficulties if the workplace has several mechanisms.

If we create a signal on each SmartComponents needed, these components need to be connected. Fig. 3 shows the basic design controller. Components must be connected with each other to receive and send data, as in the actual workplace.

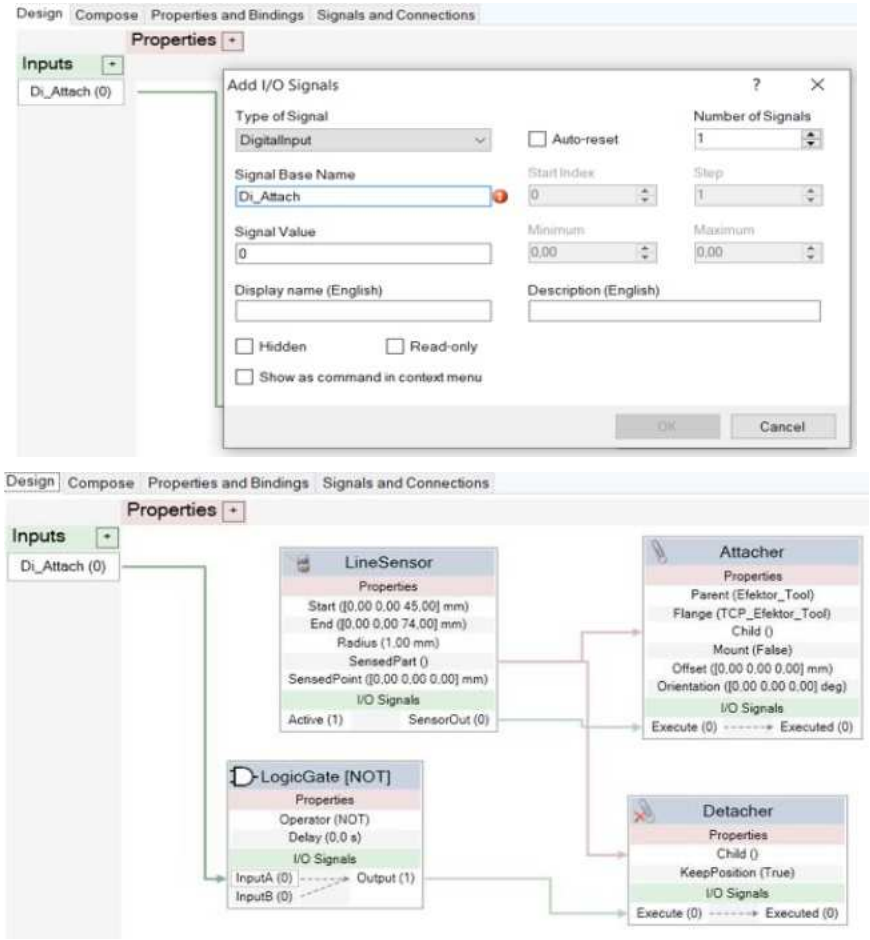

Fig. 3. Design of SmartComponents for Tool

After creating a tool design, must add additional workplace components as well as each section to create SmartComponents. To determine the stops of servomotors, you need to add 2 sensors to the end of the conveyor. We will save these sensors horizontally. The bottom sensor will detect the SM072 servomotor and the upper SM155 – servo motor. We will create a new SmartComponent, where we will add Linesensor twice in the Compose section. Describe Linesensor_inf and Linesensor_sup. We must save them correctly after adding them. If we have this step done, we add other necessary components in the SmartComponent in the Compose [9].

The last step for the proper operation of this workplace is the connection of the programmed sections in StationLogic we find in the Simulation section. Before starting, we will add signals that we connect between them. This link is shown in Fig. 4.

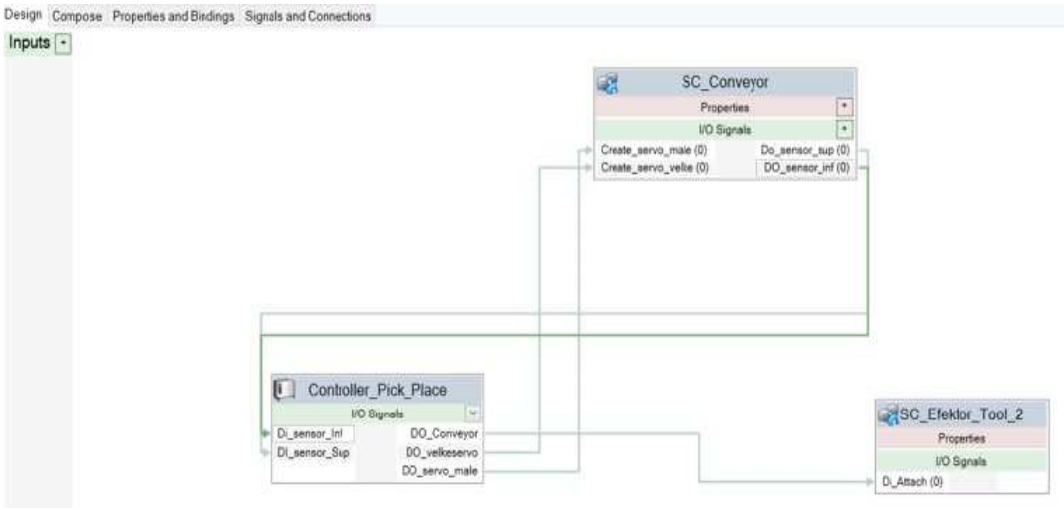

Fig. 4. Design in StationLogic

At this last point, we created a path to sort and transfer the servomotors that will be stored in templates. We will create four Workobjects first. We will create Targets in each Workobject. Wo_pick serves to lift the servomotors. Wo_place_male is used to locate the SM072 and Wo_place_velke serving serves to save the SM155 servo motor. The last Wobj0 serves as a home position. Fig. 5 shows these created Workobjects and Targets with the resulting simulation [10].

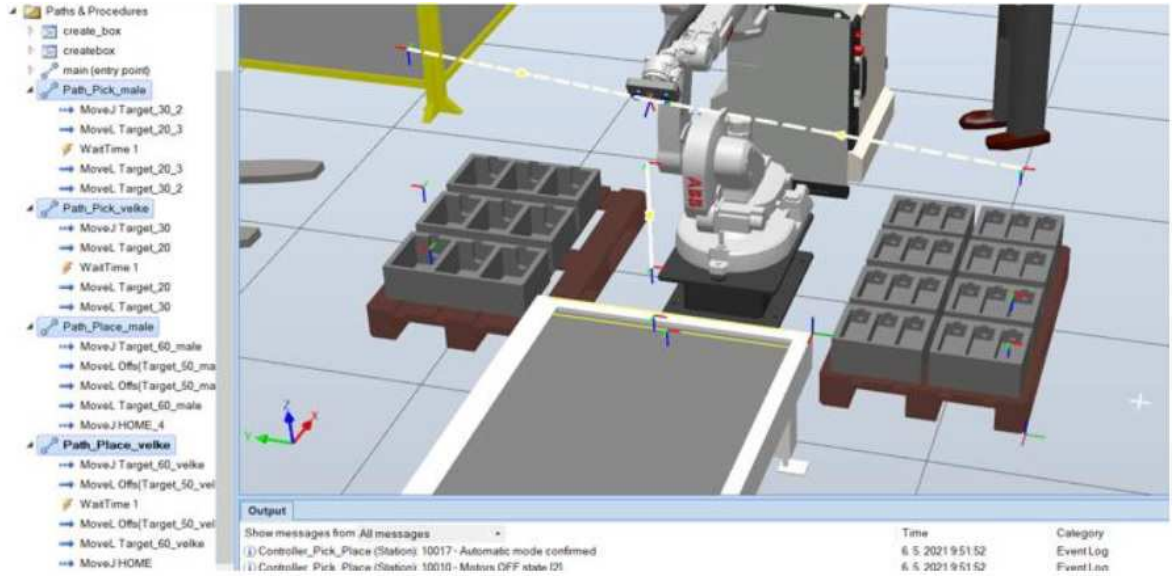

Fig. 5. Workstation with created Paths and Targets

Conclusions. The aim of this article was to create robotized workplace in simulation environment RobotStudio for pick and place operation. A primary element of the workplace is the IRB 1660 ID with a virtual controller. Other parts were created in SolidWorks or Creo. It was necessary to create a custom vacuum effector with which the objects were transferred. This was the servomotors in this case. After the workplace is created, it was necessary to use functions for importing objects, creating Paths, Targets and the main goal was to work with SmartComponents. With this tool, various sensors and signals have been created thanks to which the resulting cooperation of robot, tool and conveyor was possible. This knowledge can be used in technical practice, but also in education process. In the future, it would be necessary to create a real workplace for pick and place operation and created RAPID code to upload into the ABB robot.

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РОБОТИЗОВАНЕ РОБОЧЕ МІСЦЕ ДЛЯ ОПЕРАЦІЙ ВИБОРУ І РОЗМІЩЕННЯ В ПРОГРАМІ МОДЕЛЮВАННЯ ROBOTSTUDIO

Промислові роботи пов'язані з основним аспектом автоматизації та роботизації виробничих процесів і в даний час є основним елементом роботизованих робочих місць. Вони полегшують роботу людей, замінюючи їх на монотонних операціях, покращують не тільки якість продукції, але і точність технологій або маніпуляцій.

На основі аналізу багатьох публікацій зроблено висновок про надважливість операції завантаження 3D-об'єктів у середовище моделювання.

Метою статті є створення проекту роботизованого робочого місця для сортування сервомоторів. Для моделювання робочого місця було використано програмне забезпечення RobotStudio. Дані з інших ресурсів були імпортовані в середовище, але основний елемент був використаний з бібліотеки - робот IRB 1660ID з віртуальним контрлолером.

У роботі представлено проект роботизованого робочого місця, створений в середовищі моделювання RobotStudio. Проектування включає в себе вибір станцій, подальшу вставку компонентів з бібліотек та вставку створених компонентів з інших джерел. Створено макет роботизованого робочого місця. Представлено програмування окремих елементів робочого місця за допомогою SmartComponents та подальша демонстрація моделювання роботи роботизованого робочого місця.

За допомогою SmartComponents були створені різні датчики та сигнали, завдяки чому стала можливою взаємодія робота, інструмента та конвеєра. Інші частини були створені в SolidWorks або Creo. Запропоновані в роботі ідеї та отримані знання можна використовувати у технічній практиці, а також у навчальному процесі. У майбутньому передбачається створити реальне робоче місце для операцій вибору та розміщення і створити код RAPID для завантаження в середовище ABB.

Стаття є публікацією науково-методичного характеру.

Ключові слова: *роботизоване робоче місце; вибір та розміщення; моделювання; SmartComponents; RobotStudio; офлайн-програмування.*

Рис.: 5. Бібл.: 10.

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