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## CAD AND VR SYSTEMS APPLICATION TO CREATE INTERACTIVE VISUALIZATION OF CONTROL PROCESS IN ROBOTIC SYSTEM

**Abstract:** The article describes the use of CAD and VR systems to create interactive visualization of control process in robotic system. This concept is based on the implementation of three-dimensional models of this system in an advanced graphics program (NX 7.5), and representing its action in the virtual reality environment (EON Studio 6.1.2).

### 1. Introduction

Nowadays, the industry sets before engineers more difficult and more complex tasks requiring the minimization of financial cost. An important element is the execution time of design and construction which translates directly to cost of production preparation for the new product. In carrying out the tasks of design and manufacturing preparation very useful are advanced computer programs which support engineer work. These are mainly applications to calculate, design, simulate work, and visualize operation of future product.

Usage of the programs that supports engineering construction and manufacturing CAD/CAM and virtual reality in engineering tasks requires adequate knowledge allowing detailed consideration of all technical and technological aspects.

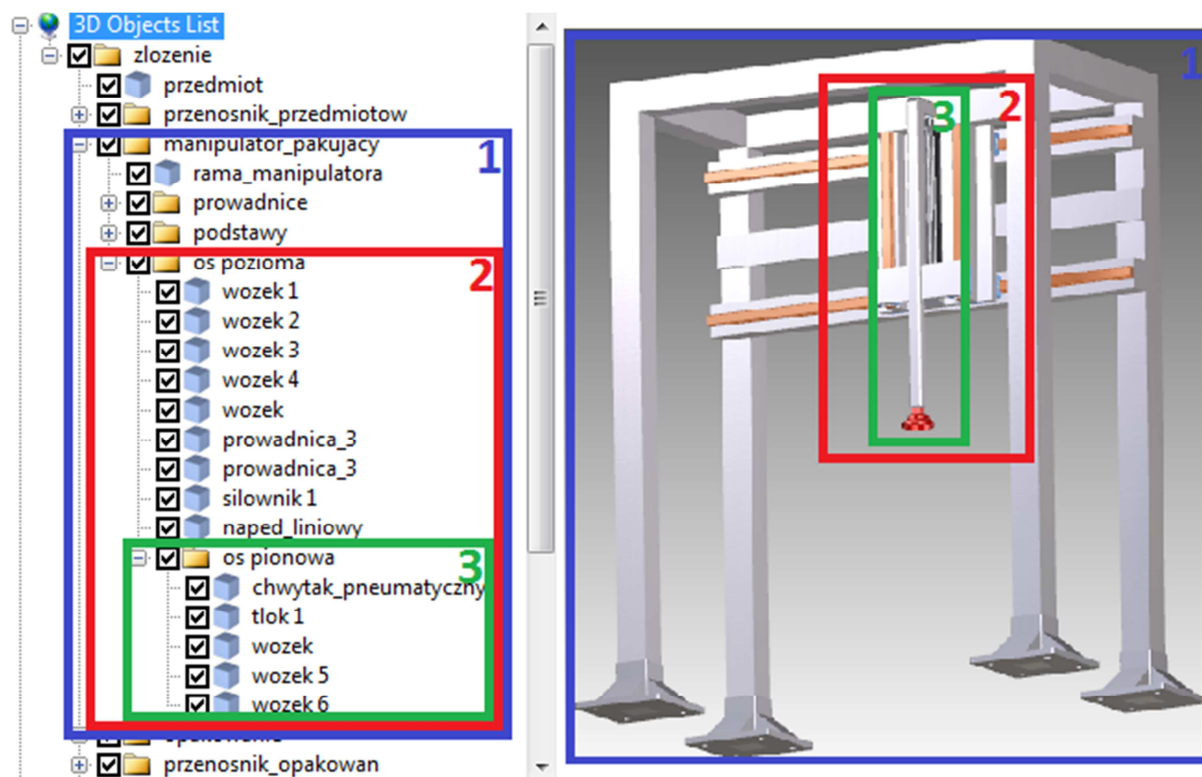
### 2. Implementation of virtual reality application to show operation and action of the robotic system

To accomplish all tasks as an example of the robotic system selected final internal transport system. Using this system ready product is inserted into the package, and the package is closed. Then the package is transported through transporter with buffer to the distributor whose function is to direct it to one of two end positions:

- the position from which the employee receives the package manually and stores them,
- the position with robot that automatically palletizing package.

Work begun with the preparation in Siemens NX 7.5 three-dimensional CAD models of devices and equipment which are components of the transport line. The assembly model of the whole transport line in a format STEP imported into Deep Exploration by Right Hemisphere. In this program all 3D models are arranged into a tree structure (Fig. 1) and

given them appropriate texture. After that, prepared model saved into 3DS format and imported it to the EON Studio.



*Fig.1. Example of device tree structure: packing manipulator (1), the horizontal axis (2) and the vertical axis (3)*

The creation of virtual reality application in EON started by defining the basic properties such as the size of the simulation window, a navigation camera during the simulation and the pivot point of the camera. Then sorted the hierarchical tree: the individual elements of the assembly are arranged in the order of flow through transport line. In addition the “control” category was created where the controlling scripts are placed and the “operating panel” category where located all the elements of this panel.

Operator panel (Fig. 2) is an interface for communication between the user and the simulation variables. In addition to control it also provides information about the state of the system. It consists of three main elements:

- the main panel – used to set initial value of simulation and display status of free place on the pallets,
- control over the cameras panel – used to select the type of view of the simulation,
- visualization of sensors panel – used to provide information about current state of the sensors and the signals they send.

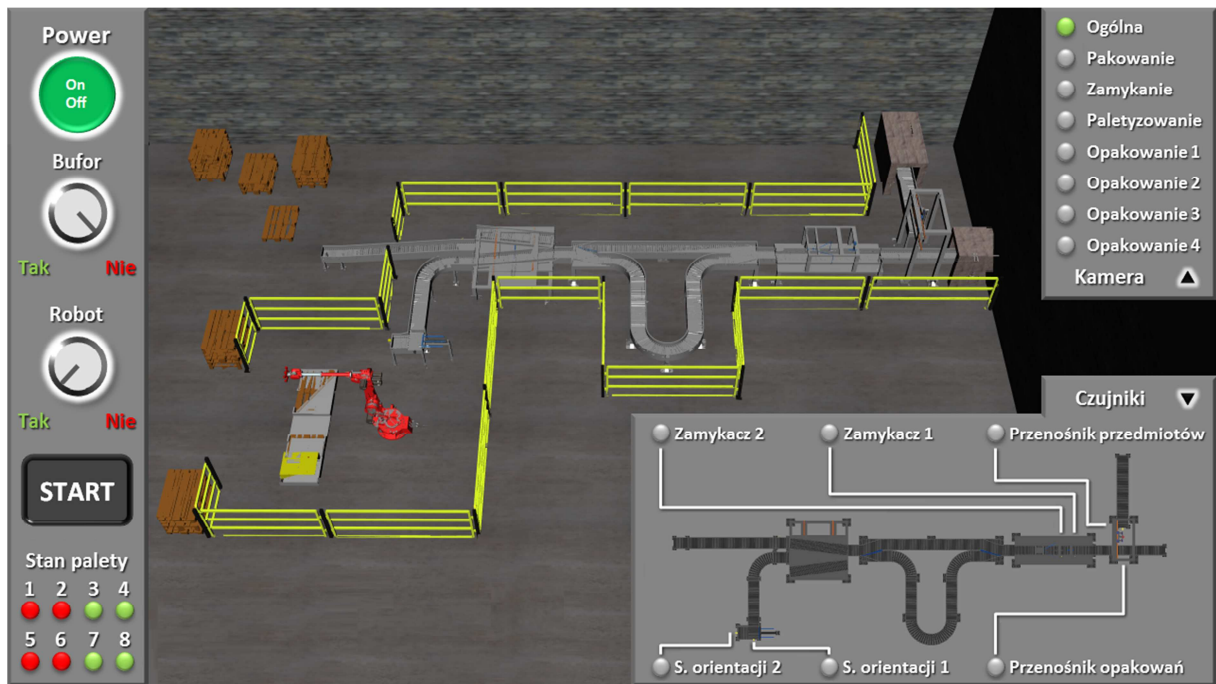


Fig.2. View of the application of virtual reality with visible operator interface

The next step was to define "node" object which are responsible for both receiving and sending signals and create a network of connections (Fig. 3) between them with "routes" elements. In this way prepared network is responsible for the proper operation of the system.

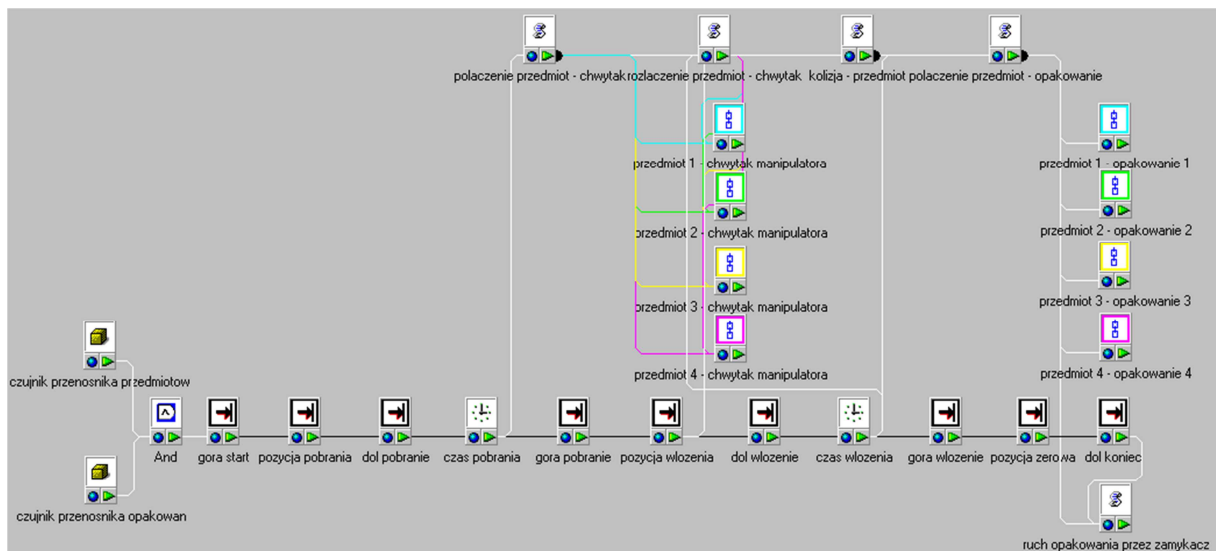


Fig.3. A fragment of the network connections between the objects which are responsible for the work of packing manipulator

Automatic operation of the line is based on the use of virtual sensors. These are 3D models of real sensors which have been given the attributes to detect and send information about the collision to the "script" objects containing control scripts written in Visual Basic

language. These scripts responds adequately to input signals and send further information to launch proper actions and sequences of the transport line.

### 3. Summary

The use of simulation programs, which allows to create virtual reality, allow to create visualization of control signals flow in a real system at the stage of the project. Define virtual sensors allows to perform a simulation that runs automatically and acting on the same principles as the real one. Unfortunately for proper operation simulation is necessary to use a computer with a sufficiently high performance. When there is not enough computing power then smoothness of simulation is weak, and this can lead to the malfunctions of the solutions.

The considerable possibilities of virtual reality in the design of robotic systems primarily include: verification of the system at the design stage, opportunity to present projects to potential investors and training future operators of the devices.

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