Visualization systems for industrial automation systems

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Abstract. In currently designed industrial automation systems, a very important task is fulfilled by appropriate legible and properly designed system visualization. You cannot imagine, for example, a control room in a power station where there are lights, recorders and switches located on the walls. Currently, all power plants or, alternatively designated areas are controlled by automation systems with SCADA systems. These systems allow you to observe variables, change their status, record in real time as well as archiving variables, creating transparent charts, etc. operations [1-4,5,6]. The subject of the article is to present the real object of a high bay warehouse with a SCADA environment as a supervisory control. In the Proficy iFix environment, a visualization was made thanks to which the operator has the possibility to change the process of using the virtual buttons and manually entering setpoints. In addition, the amount of process data obtained is significantly increased, which facilitates and speeds up the operator's decision making. The machine status data is presented in the form of virtual signaling lamps, displayed values of process variables, graphical representation of process variables, and animation of the high bay warehouse execution member reflecting the actual traffic.

1. Description of the object

SCADA systems (Supervisory Control And Data Acquisition) are currently very often used for the supervision of production processes. They allow you to get a quick overview of the actual condition of devices, enable quick location of alarms, or automatic response to specific signals coming from devices.

At the Institute of Engineering Processes Automation and Integrated Manufacturing Systems, Faculty of Mechanical Engineering, Silesian University of Technology undertakes research related to the automation of industrial systems and intelligent systems [1-8, 11-13]. The Institute's researchers also cooperate in other foreign centers [15]. The high storage system described in this article has been installed in the Laboratory of Simulation and Visualization of Mechatronic Systems in the Center of New Technologies of Silesian University of Technology.

The modern SCADA system in the graphic layer is responsible for presenting dynamically changing information. The user can determine any algorithm and recipe supporting process supervision. In the article visualization of a high bay warehouse was presented (figure 1).

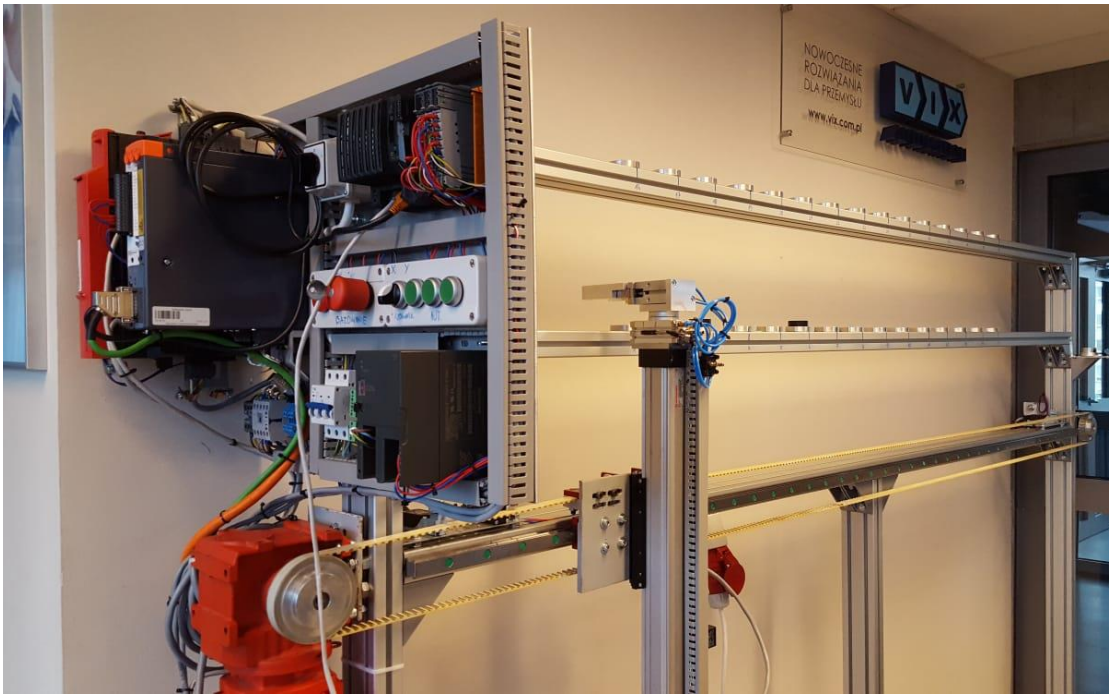

Figure 1. View of high bay warehouse.

The presented machine has two separate axes with electric motors controlled via frequency converters. The several independent drives cause the need to link their movements with each other and the implementation of individual activities according to the required operation algorithm. Therefore, a master control was used in the form of a PLC with industrial local networks to distribute data in the control system. Easy access to information transferred via the TCP / IP protocol, allowed the addition of supervisory control SCADA. The main role of the high storage warehouse is the transport function of subassemblies, i.e. the deposition and retrieval of stored details according to a specific algorithm. The high bay warehouse drives should meet the following assumptions:
- ensuring the right and left movement of the actuator in the X axis,
- providing the actuator movement up and down in the Y axis,
- the ability to set the speed of the X and Y axis drive,
- the position of the X and Y axis drive can be specified,
- the ability to stop the drive in any position,
- the ability to control work through the master device, [9, 10, 16,18-20].

Control in the X axis. Control in the X axis. In the implemented project, the motion of the manipulator in the horizontal axis is carried out by the trolley on linear guides. The trolley is permanently connected to the toothed belt, which is driven by gears. SEW components are used to drive the active pulley. The drive is implemented by an asynchronous three-phase motor with a worm gear - SEW S37 DT71D4 model - a drive unit providing torque to drive the toothed belt through a toothed pulley. The speed obtained at the output from the gear unit is n = 135 rpm at nominal speed of the motor. The transmission ratio is i = 10.23. The nominal drive torque of the gearmotor is M = 23 Nm.

Control in the Y axis. The vertical working movement is carried out by an AC synchronous motor together with a frequency converter and a helical gear that converts rotary motion into a linear one. The helical gearbox with guide rails and trolley are integrated in one housing, which makes them relatively small dimensions of the movement element. A characteristic feature of synchronous motors is their compact design at high power, the rated speed is n = 6000 rpm at rated voltage U = 330V, nominal torque M = 1 Nm, and P power = 0.63 kW [12].

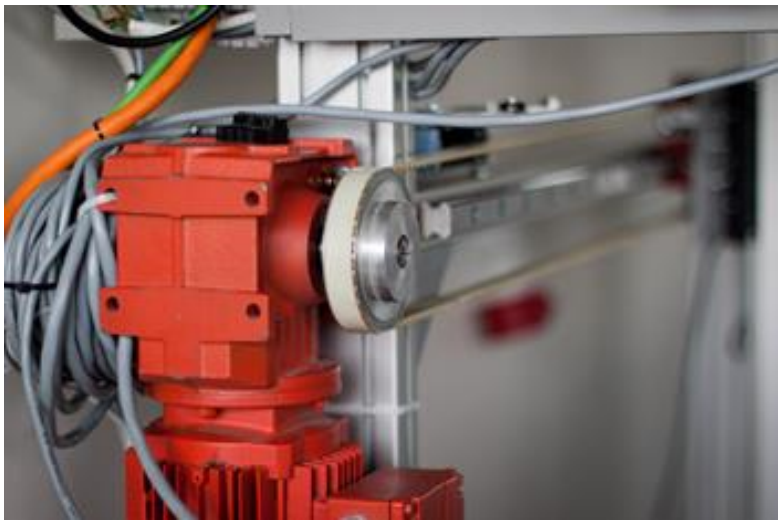

Figure 2A. View of the drive X axis.

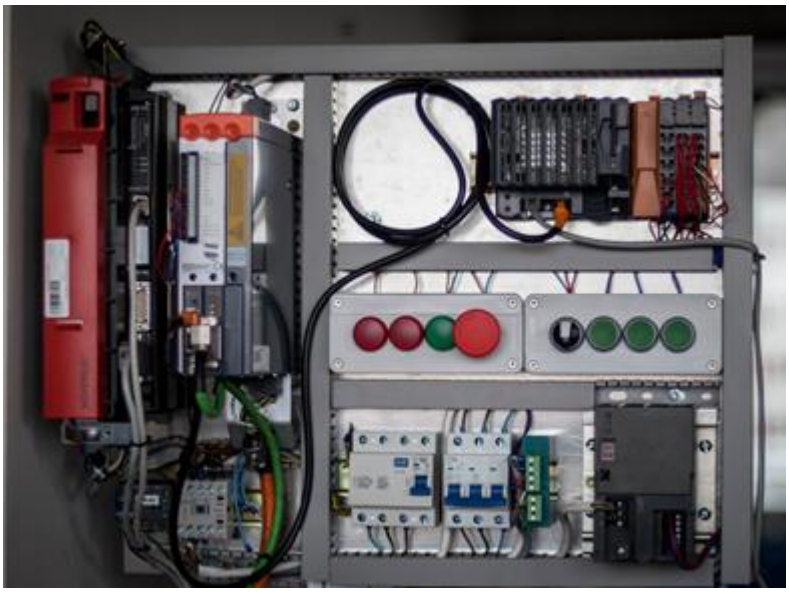

Figure 2B. View of the control system with PLC controller.

The superior control system. In order to enable error-free operation of two numerically controlled axes according to a strictly developed algorithm, the central control unit B & R X20CP1584 was used as a logic PLC. Collection of process data from drives is done using the communication protocols of the local industrial network, which gives the possibility to control their states, functions and parameters from the level of the control program executed in the PLC.

Gripping system. In order to properly operate the high storage warehouse, it is necessary to grasp the element and move it in the designated place. Taking into account the need to operate two storage levels and a detail collection station, the gripper should be able to turn on.

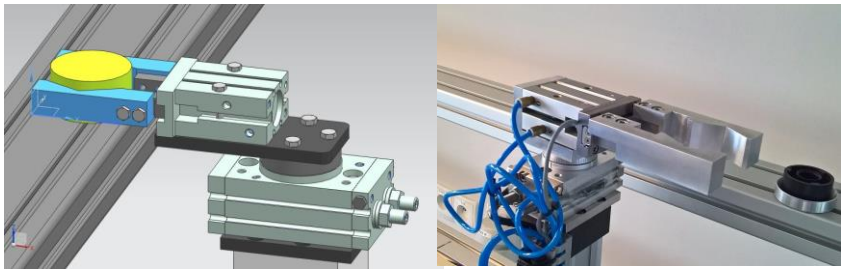

Figure 3. Gripper; computer model (a), real object (b).

The visualization of the device has been made in the IFIX program. This is a visualization and process control system used for over 25 years on the Polish automation market. It gives the possibility of precise monitoring and control of all aspects of the production process, as well as devices. It enables faster response to problems, reduction of material consumption, improvement of quality, shortening the time of introducing new products to the market and higher profitability of production.

By applying the visualization, it was possible to constantly control all variables present in the project. Due to the duplication of the functions of the operator panel on the visualization made in the SCADA environment, it is possible to fully control the work of the high bay warehouse from the workstation with the implemented visualization, without the need for interference from the operator's panel.

SCADA visualization:

- enabling the movement observation in two axes of the actuator in real time,
- graphic presentation of the storage level of the warehouse,
- support for basic warehouse control functions (homing of individual axes, activation of automatic mode),
- support for additional warehouse control functions (erasing drive errors, deleting register values),
- manual control of the pneumatic actuator system: rotary actuator and gripper,
- displaying process data in the form of signaling lamps and displaying variable values,
- emergency mode support, after moving over one of the limit switches in the X axis, which are responsible for protecting the drive against exceeding the range of motion.

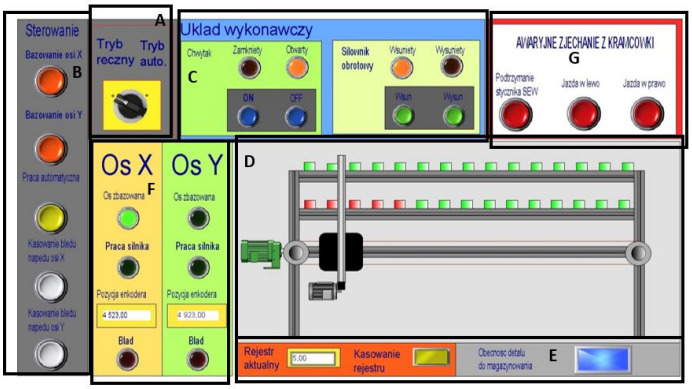

Figure 4. View of the visualization.

The first blocks marked in figures 4 as A and B are control blocks for the X and Y axis drives. In addition, block B enables the homing mode of individual axes. Block F displays process data from the X axis drive, signals the operation of the drive. The information is presented in the form of a virtual signal lamp, which changes its state depending on the value of the input signal. Block C informs about the status of pneumatic actuators with the function of controlling them. Next block E displays numerical information about the state of storage. On the visualization screen, a data corresponding to

the number of parts in the magazine appears is visible. The G block is the error reset block in case when the X axis drive exceeds the range of motion, the motor is cut off from the power supply. The main block is Block D with the motion animation of the executive element.

2. Conclusions

Production speed and reliability - these two are very important in the world of industrial automation. The development of technology enables to control any object faster and faster with greater accuracy. Each production process consists of several components whose respective assembling and scheduled work is important for proper implementation of the element. Often, the information between the components of the production line must be transmitted immediately in real time to ensure the correctness of the cycle.

In recent years, the number of industrial automation applications in which SCADA systems were applied significantly increased. These systems not only in large companies such as power plants but also used in smaller production lines are used. Numerous advantages determine the popularity of these systems.

In this article a high bay storage device was shown. The system was made as a teaching device on which research on automation systems is carried out. In addition, the device is equipped with a SCADA system that allows remote supervision over all technological parameters.

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