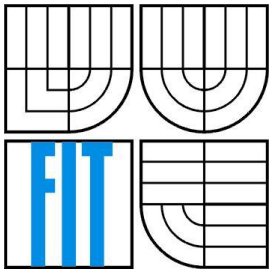

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SERVO CONTROL SOFTWARE FOR THEATRE ENVIRNOMNET

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Introduction

Industrial automation techniques are used to control devices in the stage technology – this is a reality of today. The automation techniques provide typically a centralized management of all the theatre devices from a single place, at least from the users point of view. The diagram below shows the combination of control panels with visualization units (CP), which communicate via communication buses with the management program (MP). It sends commands to operate specific device. Most of the theatre equipment contains electrical motor drives. Some of them must be continuously controlled; those are provided with frequency changer (FCH)

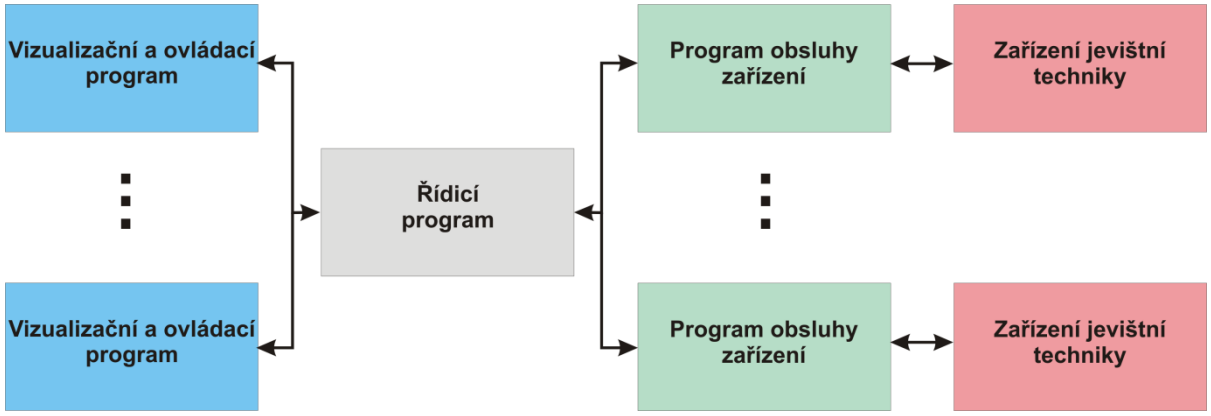

Fig. 1. Block diagram of a typical stage technology system

Description

This software package enables control of the theatre devices of the “slot” type. With no or minor modifications, however, it can be used on other types devices not only in theatre environment, that use similar motors and sensors. The platform necessary for running the system (all its parts) includes industrial computers with Windows (e.g. Windows CE) operation system. The service of equipment program is designed for Altivar 71 frequency changer, produced by Schneider Electric, connected to the CAN bus (some variability within the controllers, however, exists). As a module implementing the CAN bus on the computer, the DataLab IF/CAN, produced by Moravian Instruments Inc., is used. The individual software modules are programmed in the ControlWeb environment version 6, produced by Moravian Instruments Inc.; to ensure good functionality of the whole system, is necessary to have a valid license of this software tool. For the communication between different parts of the software, Ethernet technology is used. The system was tested on the theatre devices produced by Elseremo Inc. Diagram of overall system is in Fig. 2.

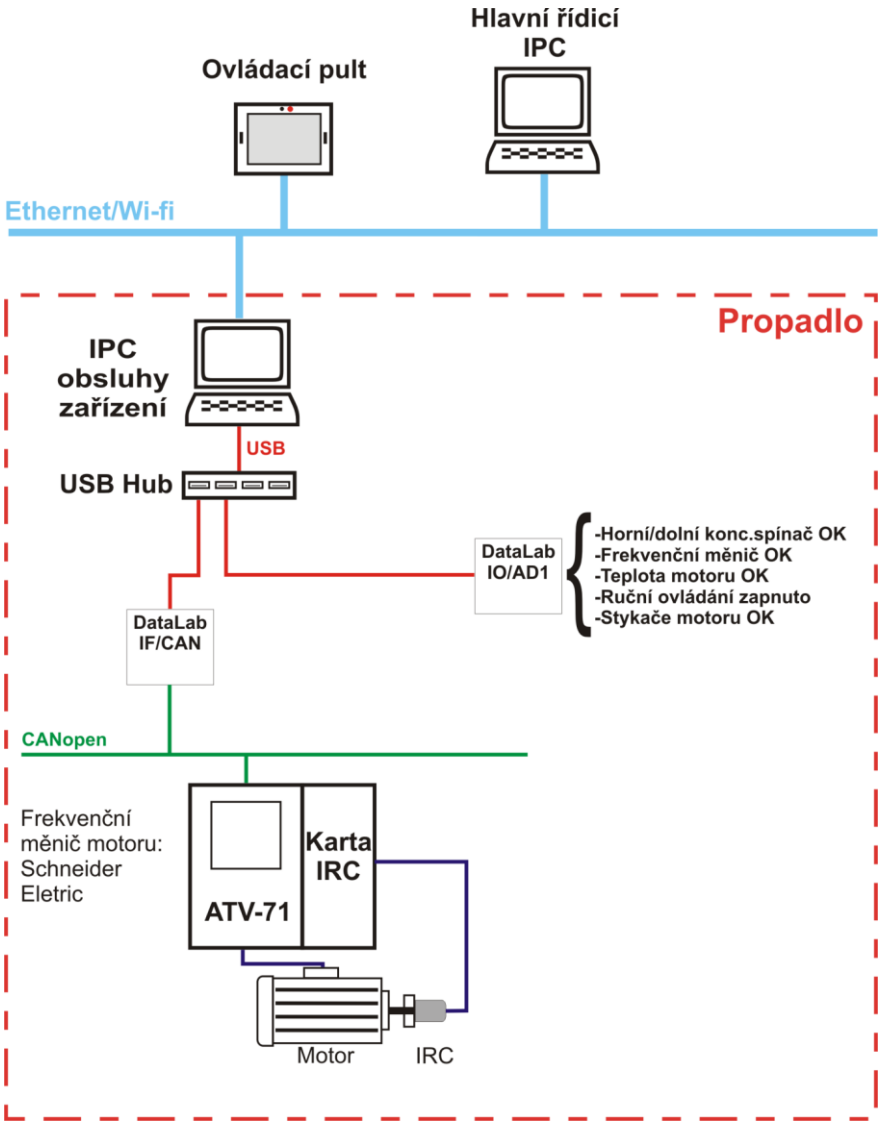

Fig. 2. Connection diagram

Application for the control panels

The software application is intended for visualization of the theatre devices and their states, and specifically for their control. (This part must be modified if other devices are used, to fulfill ltheir requirements). To ensure proper functionality, It is necessary to properly configure the MP via Ethernet. Each CP has a unique ID, to enable unambiguous addressing of the theatre devices. At the beginning of exploitation of the programme, it is required to log on. This is necessary to ensure system security and access only for specific persons. If the login/authentication process is successful, applications attempt to connect to the MP and loads information about the devices. The main window is divided into several tabs as shown further.

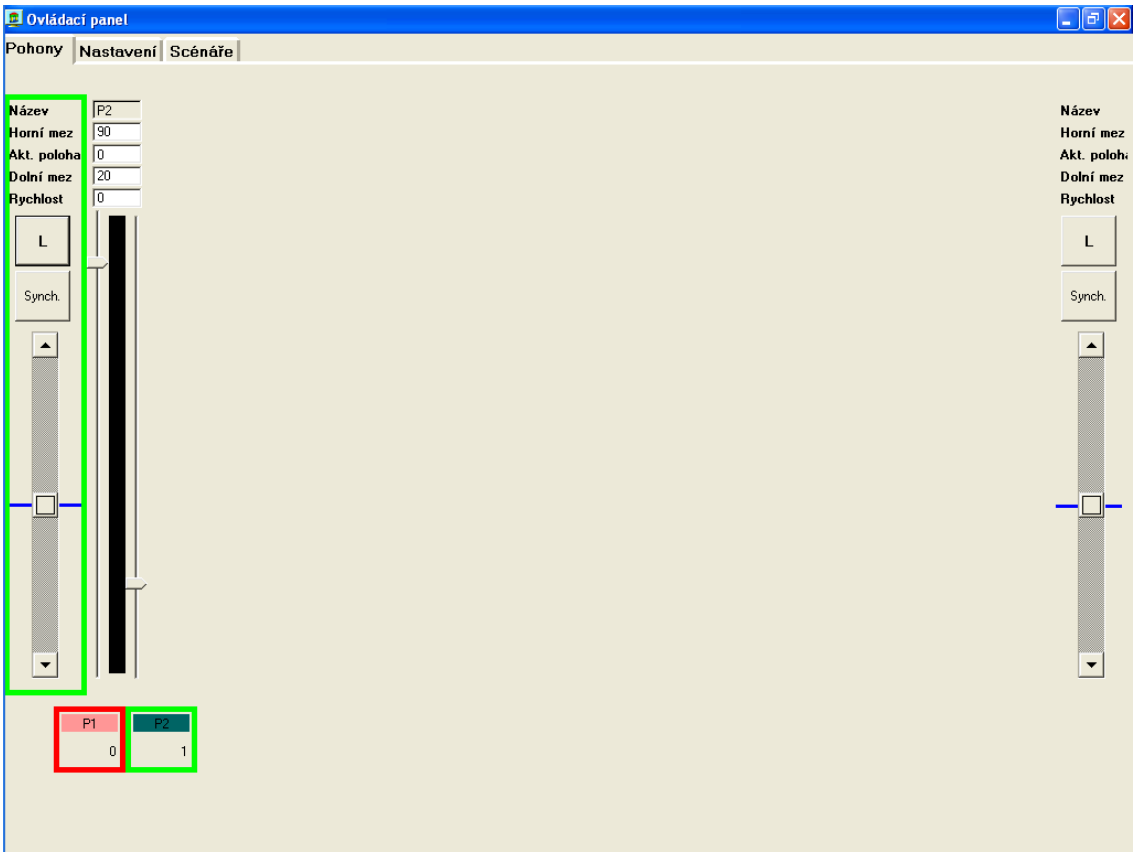

Fig. 3. First tab of application for the control panels

In the „Pohony“ tab, the two control levers (right and left) are shown along with their settings. The lower part is filled with a list of buttons corresponding to the available devices. These buttons are displayed when the application connects to the MP and loads the configuration. Each button represents a physical device with certain properties. Visualization of device is changing according the status of the real devices.

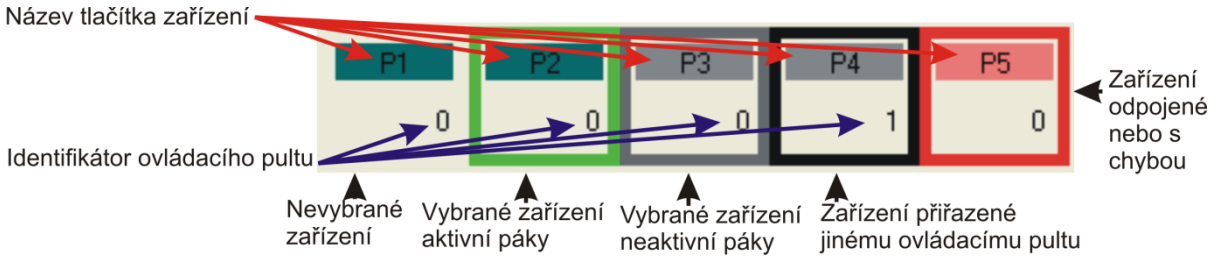

Fig. 4. Various forms of the device control buttons

Each device can be handled only in one “CP” and by only one of the levers. If the device is already selected, the application disables re-use elsewhere. The selected device is displayed on the associated control lever. Additional settings of the devices are possible through the associated menu. Specifically, the maximum speed and the upper and lower limit of position are possible to adjust. Graphical slider displays the current position of the device.

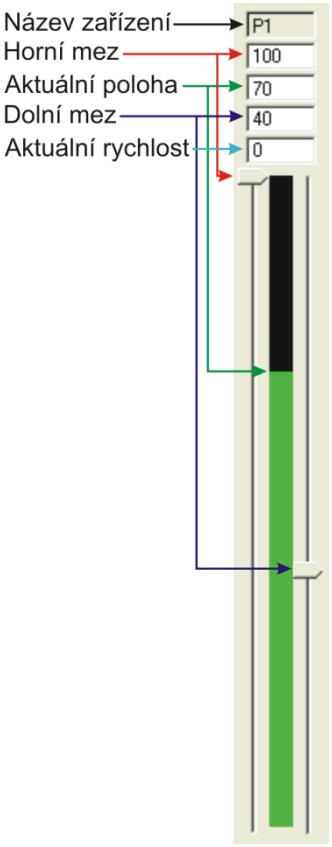

Fig. 5. The appearance of the device on control lever

If the device to be set is in motion, the “lock” button must be pressed first (located above the lever) and one of the drive control modes must be selected. The software application supports asynchronous mode with setting limits for each product and time-synchronous mode. Deflection of the lever upwards direction is given up and a group of equipment is put into motion. The device speed is set as a percentage deviation of the intensity of the lever form 0% (idle status) to 100% their maximum set speed. If the lever is moved in the opposite direction, the group moves the device opposite comparing to the normal movement.

The next tab of the application is „Scénáře“. It is ready for future development. It should also should serve scriptwriters ready for theatrical performances.

Tab „Nastavení" allows to configure the application, change network settings, and permitting users to access. This tab appears only if the user has the administrator permission.

Requirements

- Computer type PC/IPC.
- Windows CE operation system.
- Control Web version 6.
- Application visualize.cwu located in the attached package with the necessary libraries.
- Free Ethernet port.
- Monitor.
- Keyboard, mouse.

Management program

The management program is the “brain” of the whole system. The communicating with the program is done through the “service equipment” process (SE), which receives requests for the changes to the devices and issues commands for the equipment accordingly. The requests for changes are done through the commands coming from the “OP”.

All the connected equipment is automatically gathered into a list of equipment available to the “SE”. Each device in the list receives its unique identification number – UID; the UID consists of “SE” numerical identification and identification of the equipment type.

Requirements

- Computer (PC/IPC required).
- Windows (typically Windows CE) operating system.
- Control Web version 6.
- Source code of the application (control_system.cwu) located in the attached package along with all the necessary libraries.
- At least one free Ethernet port.

The equipment software service module

The equipment service software module in the only piece of software directly communicating to the hardware involved in the stage technology. This software module communicates via the Ethernet port with “MP”. The module receives only very simple commands, such as “set speed”, “stop”, “configure communication and devices”, etc. Each hardware unit uses its unique network identifier (UID) as an identifier for communicaton. After the application starts, the configuration of all the devices, including their UID numbers, is loaded from a database file that determines system configuration.

The module was created in order to connect the stage technology “slots” equipped with synchronous AC motors and allows for fully controlled motion of individual pieces of equipment. Communication with the “frequency controller” is accomplished through the CAN bus using CANopen protocol implemented in the DataLab IF/CAN module.

Each “slot” can be using several control points that must be continuously evaluated. An example Is the “safety switch” placed on each of the end positions of the servo equipment. The connection to the PC/IPC is accomplished through the DataLab module IO/AD1 equipped with general purpose digital inputs DataLab. The software captures also driver exceptions and safely stop device if there is any breach of security conditions. The MP is informed about this fact through an error message.

The devices (slots) may be in one of the three internal states - RUN, STOP and ERROR. In the RUN status, the device can operate normally, it is ready to receive commands, and it generates output based on its activity. STOP status indicates that the device is not ready; most often such status occurs just after initialization of the whole system has taken place. ERROR status occurs if any problem occurres; it can be loss of Ethernet connection, disconnection of the equipment, or breach of safety conditions. The device cannot be restarted until the problem is resolved and the device will not

switch to the RUN status. Any changes to the internal state of the devices are sent to the control system and they are archived for possible future needs (e.g. diagnostics).

For the actual control of the servo drives, PID type controller is being used. The input for the regulator is the desired position of the drive and maximum speed. Additionally, the PID regulator exploits information, such as maximum acceleration, etc. to achieve the best available “trajectory”. The actual setting of PID parameters has typically to be done experimentally as often not all the necessary information about the drive ins known from the specifications obtained from the manufacturers.

Requirements

- Computer (PC/IPC required).
- Windows (typically Windows CE) operating system.
- Control Web version 6.
- Source code of the application (device_service.cwu) located in the attached package along with all the necessary libraries.
- At least one free Ethernet port.
- USB port.
- DataLab IF/CAN and DataLab IO/AD1 modules.

The package content

/can.dmf
/can.par
/control_system.cwu
/devbutton_lib.cwu
/device_library.cwu
/device_service.cwu
/visualize.cwu
/README.txt
/README_EN.txt