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PLC PROGRAMMING IN LABORATORY OF PRODUCTION SYSTEM PROGRAM CONTROL

ABSTRACT:
Currently, the emphasis on improving the effectiveness of automation in industry. One of the base parts for automation is control devices such as different PLC systems and programming environments. This programming environment for PLC system use in laboratory of production system program control. Base for the control of real output per axis manipulator, a schemes is possible in the virtual software followed by simulated and tuning errors. Thus the scheme is then verified recorded in PLC control and prepared to manage the various movements of the manipulator.

KEYWORDS:
PLC systems, manipulator, automation, sensor, virtual laboratory

INTRODUCTION

Within the solution of KEGA grant task, which is being solved at the Institute of Production systems and Applied Mechanics STU Bratislava in years 2009-2011, there is an opportunity to develop the abilities and skills that employers usually expect from the graduates of technical universities. The main goal of this project is to create a virtual laboratory of manufacturing devices programming control and build a suitable system of teaching that will support the creation and consolidation of professional key competences. The result presents both virtual programming PLC with a feedback simulation and checking the graduates´ skills that would support their preparing for practice and whole-life education. The demands on graduates´ skills and their job market preparedness are deeply analyzed.

PRINCIPLE OF PROGRAMMABLE LOGIC CONTROLLER OPERATION

Operation of PLC - the program stored in memory periodically evaluates input signals and set the output.
Using PLC - PLC is used in machine tools, material handling, automated assembly, and in many other industrial applications.
Preparation of PLC and its structure, types of input and output units
The basic structure of the PLC:
Compact (Fixed Hardware Style)
This copy is cheap and is used more for simpler applications. Configuration variability is low with it. Usually have a limited number of digital inputs, digital outputs or analog input or output. Some compact PLCs also have the option to extend the variability of configurations using additional modules.
Modular (Modular Hardware Style)
It is suitable for demanding applications. This allows much more variable configuration. The basis of the frame (rack, chassis), which in its left is the resource. The rear frame is driven internal bus on which the connector module. Frame length varies according to the number of slots for insertion module (unit). As the first module from the right source plug-in CPU (processor) and then followed by further input / output modules (I / O modules).
Function parts PLC:
CPU - central processing unit
- *control all operations in the PLC,*
- *performs programmed sequence of instructions stored in memory,*
- *CPU can be implemented as a separate module that can add input and output circuits (ie, other modules).*

Memory - into PLC memory is stored
- *technology program management process,*
- *titles and operating system PLC.*

Input and output circuits
- *connecting PLC to sensors and actuators, where the galvanic separation of signals,*
- *A / C and C / A conversion of continuous variables (current, voltage, resistance),*
- *each input and output PLC has a (unique) address through which they can access it (write to it or read it).*

Programming the device

- *configuration and PLC programming [1].*

Programmable logic controller PLC is a digital computer consisting of a programmable memory for internal instructions saving. It performs different specific functions such as logical, sequential, timing and start-stop functions by means of digital or analogue input and output modules. More simplified, PLC can be characterized as an industrial digital computer designed especially for controlling in the field of industry [2].

Type of PLC depends on the complexity of controlled technology. Choice of PLC type depends on the application in service. Small PLC is sufficient for plants with simple technological cycle. For automated production and assembly halls it is suitable to use big PLC mainly because of the possibility to extend it by input or output modules and communication interface integration.

Nano PLC and Micro PLC are used as substitutions for switching relay. They control devices like parking automata, manipulators, and machine tools. Their size is very similar to a relay. Small PLC, sometimes called SLC (small logic control), is suitable for plants where PLC performs independently. PLC usually contains an integrated pushbuttons package and an internal LCD display.

FUNDAMENTAL STRUCTURE OF PLC SYSTEMS

Fundamental structure of PLC systems is identical for any PLC (fig.1). Differences are mainly in other options of its expansion. PLC structure is composed of the following parts:

- *power supply,*
- *control processor,*
- *inputs and outputs (binary, analogue),*
- *program memory, memory for variables,*
- *connector interface for program loading,*
- *other peripherals (floating battery, memory card, RTC, communication conductor bar).*

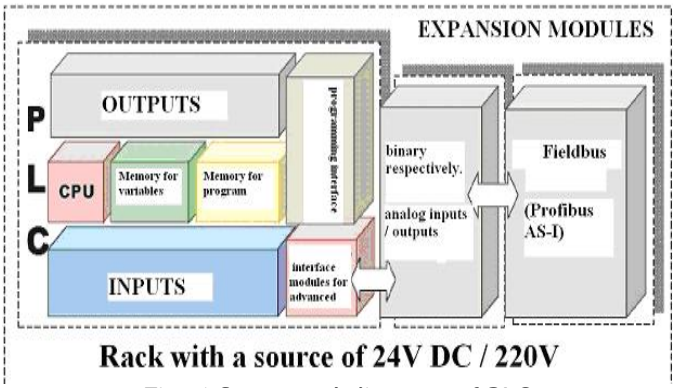

Fig. 1 Structural diagram of PLC

PLC Programming Alpha used in the laboratory of manufacturing devices programming control is performed by assembling functional blocks of logic with the help of members [3].

PROGRAMMING METHOD

Controlling and programming of these devices is a very important field of study. For particular manipulator (Fig.2), we used PLC Alpha Controller for cycle automation.

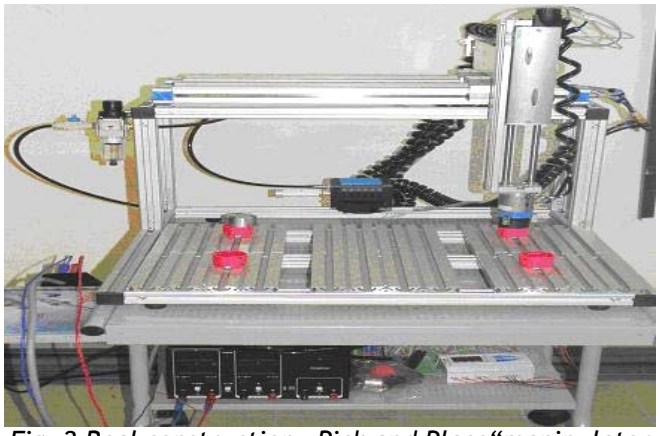

Fig. 2 Real construction „Pick and Place“manipulator controlled by PLC

The workplace of one purpose manipulator “Pick & Place”

The one purpose manipulator consists from pneumatics actuators and components and the main frame is realized out of aluminum profiles [4].

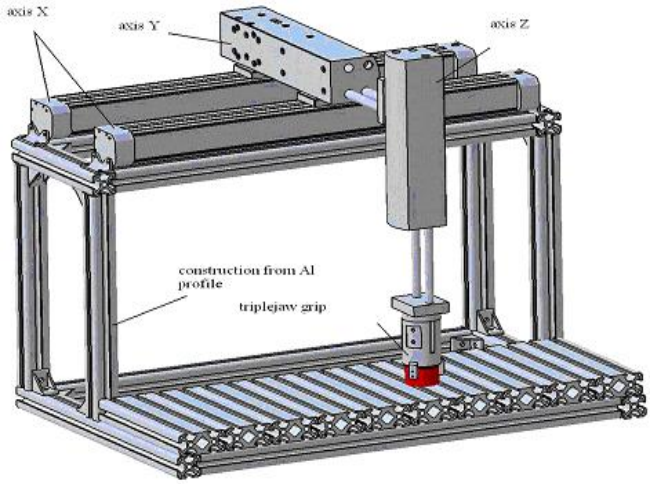

Fig. 3 Three-axis pneumatic „Pick and Place“ workstation design

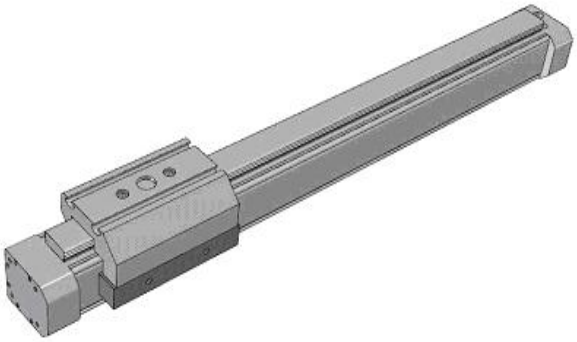

Fig. 4 The X - axis drive (direct pneumatic driver DGPL-25-350-PPV-A-GF-B)

The X - axis drive

The X-axis drive is marked as DGPL-25-350-PPV-A-GF-B. It is linear pneumatic actuator with plain bearing. .

- *DGPL – linear actuator,*
- *25 – piston diameter [mm],*
- *350 – stroke [mm],*
- *PPV – adjustable pneumatic absorbing of end positions,*
- *A – magnetic proximity switch possibility,*
- *GF – bead fixation,*
- *B – actuator generation B*

Supplementary data:

- *Synchronization principle by shape connection,*
- *Position detection,*
- *Work pressure (2 – 8 bar),*
- *Double acting motion,*
- *Work medium – filtered, oiled or no-oiled compressed air.*

The Y - axis drive

The Y-axis drive is marked as HMPL-20-200-AI-VP-2A3. This actuator is one of type category of pneumatic actuated linear axes for assembly and manipulation equipment and devices. It is possible directly to combine between actuators and loads into axis systems and thereafter to complete into manipulators units "Pick & Place". The category HMPL is included into modular technique for assembly and manipulation HMT. It is supplemented this category by it in its construction size and utility mass to down direction. The horizontal axis with vertical axis HMPL creates system "Pick & Place". It is optimized to stiffness, dynamics and function.

Fig. 5: The Y- axis driver (linear pneumatic driver HMPL-20-200-AI-VP-2A3)

The main characteristics of this actuator are:

- *HMPL – pneumatic linear axis,*
- *20 – piston diameter [mm],*
- *200 – stroke [mm],*
- *AI – absorbing of position,*
- *VP – armature plate desk,*
- *2A3 –proximity switch position.*

Supplementary data:

- *Assembly position,*
- *Ball bearing,*
- *Work pressure – (4 - 8 bar),*
- *Double acting motion.*

The Z - axis drive

The z-axis drive is marked as HMPL-16-160-AI-VP-2A3.

- *HMPL – pneumatic linear axis,*
- *16 – piston diameter [mm],*
- *160 – stroke [mm]*
- *AI – absorbing of position,*

The actuator axis Z is one of type category as actuator axis Y. the different is only in piston diameter and stroke.

This PLC (Fig. 6) is able to process binary or analogue electric signals.

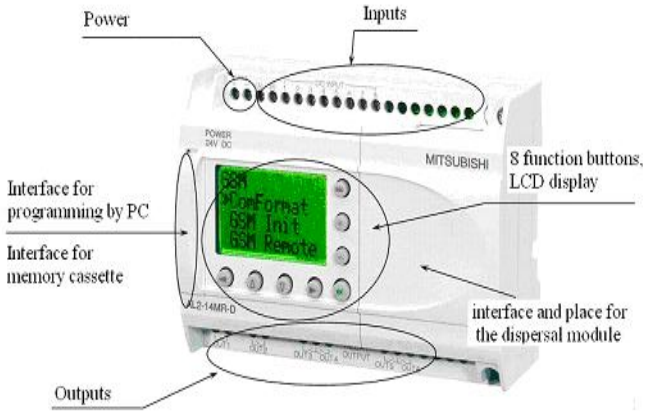

Fig. 6 Programming machine Mishubishi Alpha

Programming can be realized either with using the buttons on the front panel or by PC (software Alpha-PCS-WIN-E). By reason of user accessibility, we use the programming language FBD (functional block diagram) for programming. Then we load the following into PLC Alpha by the real output implementation from the created program in given software. Pick and Place manipulator performs single moves on the ground of sensors which are installed on it [5].

It is possible to program in two ways: direct programming or flexible programming. When we use direct programming, it is possible to programmed simplified commands with the help of pushbuttons. All performed changes will be shown on the display. Direct programming is mainly used for controlling and maintenance, eventually a small program change. Flexible programming is performed by interconnection of the functional blocks so they complete the automation task. It is possible to use up-to 200 functional blocks in one program and the individual functions can repeat arbitrarily often.

Functional blocks are available for:

- *simple and complex logical connections,*
- *attributes (parameters) setting,*
- *timers,*
- *visual display of notifications,*
- *analogue processing parameter settings (offset / gain).*

Functional blocks – a program is created by joining of main components. They enable us to process the information gained from inputs, or other source, and on their ground (according to dependency of a given stored program) switch the corresponding outputs.

It is possible to use 22 different functional blocks when compiling a program. These blocks are pre-programmed for performing of specific tasks and they can have different parameters (Fig. 7). Parameters can be changed where necessary [6].

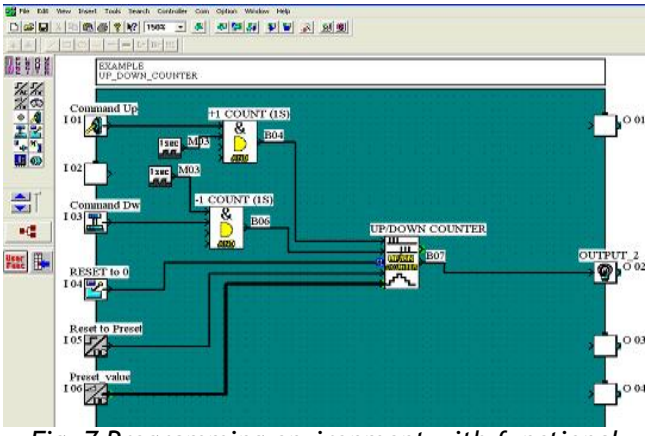

Fig. 7 Programming environment with functional blocks

FBD layout - place for positioning programming features (inputs, outputs, functional blocks, memory cells, or keys) during the programming process.
Binary value - variable type (input, output, and memory cell) can have only two states - 0 (Off) or 1 (On).
Analogue quantity - variable type has numeric value.
Program variables of different types can be edited or read by an open protocol. PC communication, utility panels communication or other PA is possible with the help of communication cable RS-232C. Created programs can be password protected. This type of security answers the purpose of programmer's copyright protection because so protected program cannot be copied any more

CONCLUSION

At present it is very important to know the flexibility to enter into the controlling process at every moment of the automatic cycle manipulation, or technology operations. Therefore, we in our laboratory program of controlling manufacturing systems to teach students to interact. Whether it is the creation of a virtual program by PLC, but also a change in real time the parameters of input and output units.

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