



Control Input/Output interface with the program for control of robotic production line segment models

Milan Sanader¹ and Gordana Sanader¹

¹M&G Dakta, Belgrade, Serbia

e-mail migdakta@sbb.rs

Abstract: *This paper is based on modernization of teaching the school subject Technical and Information Education by introducing an interface with 8 digital inputs and 16 relay outputs as a new teaching aid in the final grades of elementary school. The basic interface parts, their role and mode of operation are presented. In order to better understand the function of this teaching aid this paper presents a program through which executions are ordered to the interface by the computer. The program is presented on the operating cycle of four models from the living and work environment which are together making a production line.*

Key words: *control; input/output; interface; program; production line*

1. INTRODUCTION

The teaching program for the school subject Technical and Informatics Education for the seventh grade of the elementary school envisages, inter alia, the following teaching units: Machines and Mechanisms, Robotics, Structural Modelling..., and for the eighth grade Information Technologies, Digital Electronics. Computer with adequate programs is used to control modern devices and machines. Electronic assembly (Bartolić et.al. 1990) for connection between computer and a device is called interface. Fulfilment of goals and standards of achievement in above said fields is impossible without this device.

Control input/output interface (Filipović, 1997) with 8 digital inputs and 16 relay outputs has been designed and made as a teaching aid for the needs of teaching the school subject Technical and Informatics Education in the seventh and eighth grade. Its aim is to control the models of devices, machines and systems from the living and work environment by use of a computer. It enables open and closed control interface. For the open interface only inputs are used, and for the closed interface both inputs and outputs are used. To control the models in such a way it is also necessary to introduce serial USB interface.

The program is intended for movement control of 10 actuators, out of which 9 are micro motors and 1 is electromagnet. For 3 micro motors one rotation direction is envisaged, and for the remaining 6 micro motors two directions are envisaged.

A segment of the robotic production line (Sanader, Sanader, 2009) is made of the models of two conveyors. One is intended for transport of the blank, and the other one for transport of

the workpiece. The robotic arm is intended for workpiece handling and CNC machine is intended for making the groove in the workpiece.

1.1. Serial USB interface

The role of the serial USB interface is to achieve connection between personal computer (PC) and control input/output interface. It is based on the last generation FT234X integrated circuit which enables serial communication with control inputs and outputs through USB port. Via this interface the PC program controls the model by sending turning on or turning off commands to the control outputs which may be an electro motor or electromagnet. Serial USB interface is used exclusively for communication between PC and the control input/output interface. By USB cable it is connected with one end to the PC's USB port, and with the other end through 25-pin DSUB connector to the control input/output interface. Power supply for this interface is provided through the PC's USB port and there is no need for any additional power supply.

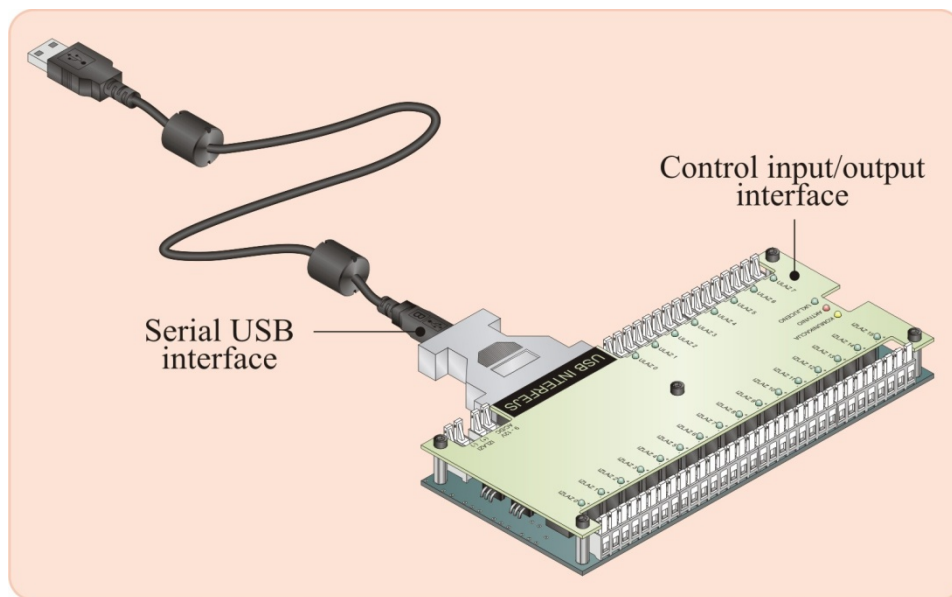


Figure 1. Serial USB interface and control input/output interface

1.2. Control input/output interface

The commands arriving from PC program through serial USB converter are executed by the control input/output interface. This device has 8 input lines to which switches can be connected, and 16 relay outputs to which electro motors and electromagnets can be connected. Connection with serial USB interface is made by use of 25-pin DSUB connector (Sanader, Sanader, 2009) and to ensure proper operation it is necessary to provide 9V direct current voltage. Connection between serial USB interface and control interface is galvanically separated by optocouplers, having insulation 3.75kV. In this way PC protection is achieved against any potential disturbances which may occur during turning on of electro motor or electromagnet. Additional protection is provided by separate power supply of

electro motor and electromagnet. Consumption of this device is in the range of 400mA. All inputs and outputs are clearly marked and each of them has LED as an indicator of active state. The control input/output interface is based on Atmel AVR microcontroller Atmega 16 whose role is to transform the command serially received from PC into a signal which turns on the outputs, or to return the state of input lines to PC. Connection of electro motors, electromagnets, switches and power supply of the control interface is achieved by micro connectors with lever which enables fast and simple use.

2. PROGRAM FOR CONTROL OF PRODUCTION LINE SEGMENT MODEL

Automated production process for manufacturing the products includes transport of the blank, handling thereof, automatic processing and dispatch of the workpiece. Model of the production line segment is presented in Figure 2. Conveyor 1 transports the blank. The robotic arm (manipulator) (Sanader et.al. 2011) takes over the blank from the belt and transfers it to the worktable of coordinate milling machine. Upon completion of milling the manipulator transports the workpiece from the worktable to Conveyor 2. The workpiece is dispatched by Conveyor 2 to the machine for the following production operation.

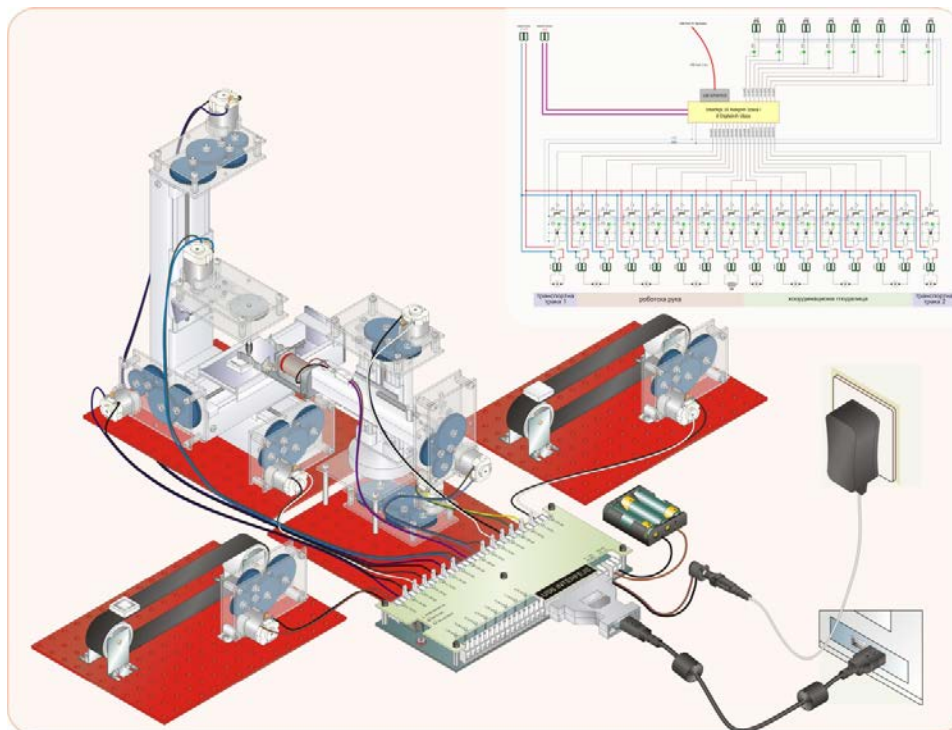


Figure 2. Model of production line segment with a diagram of executive bodies

2.1. Program – Production Line

This program is intended for control of the production line segment model. By controlling the model connected are the activities by which making of a square-shaped channel is demonstrated. The sequence of activities is defined by the program. To present the entire cycle it is necessary to adjust motor operation times for each machine based on movement parameters.

Once the program is started, there appears a window with the image of the model of the production line segment next to which there are fields showing operation times of some electro motors, Figure 4.

machine	conveyor 1	robotic arm (manipulator)				coordinate milling machine				conveyor 2
motor	T1M1	RM2	RM3	RM4	GM5	GM6	GM7	GM8	T2M9	
movement	translation	rotation	translation	rotation	enables operation of milling cutter	translation	translation	translation	translation	
movement direction	←	↻	↻	↕		↕	↗	↘	←	
time in s x10 ⁻¹ ms	2,5 250	0,66 66	0,70 70	12 1200	10 1000	15 1500	20 2000	20 2000	2,5 250	

Figure 3. Motor operation times

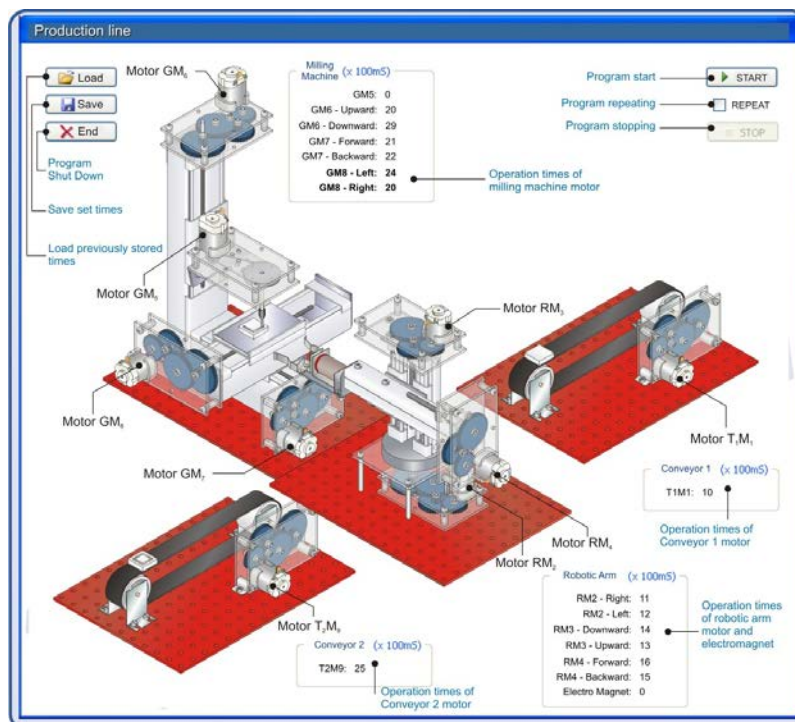


Figure 4. View of the production line program

3. CONCLUSION

Modern teaching of the school subject Technical and Informatics Education imposes a need for the use of modern teaching aids. It can be surely said that the interface presented in this paper is a modern teaching aid. It enables control of both simple and complex models and systems. Control of the model of the robotic production line segment is enabled by open control interface. Eight digital inputs provide possibility to upgrade the models with sensors and to apply control feedback. The models of the robotic production line segments provide an opportunity for pupils to have a better insight into the production process of material goods without participation of a human worker. To many pupils they can represent motivation to create the same or similar models. It should be borne in mind that this can also have an impact on professional orientation of pupils.

REFERENCES

- [1] Bartolić, J. i dr. (1990). *Inženjerski priručnik, elektrotehnika (elektronika, komunikacije i električni strojevi)*. Zagreb: Školska knjiga
- [2] Sanader, M., Sanader, G. (2009). *Tehničko i informatičko obrazovanje - Udžbenik za 7. razred*. Belgrade: M&G Dakta
- [3] Sanader, M., Sanader, G., Filipović, M. (2010). *Tehničko i informatičko obrazovanje - Radna sveska za 8. razred*. Belgrade: M&G Dakta
- [4] Sanader, M., Sanader, G., Filipović, M. (2011). *Tehničko i informatičko obrazovanje - Udžbenik za 8. razred*. Belgrade: M&G Dakta
- [5] Filipović, M. (1997). *Praktična elektronika 6*. Belgrade: Nikola Tesla Club and Electrotechnical School Nikola Tesla
- [6] Cuniberti, E., De Lucchi, L., Galluzzo, D. (2013). *Elettronica*. Novara: Petrini