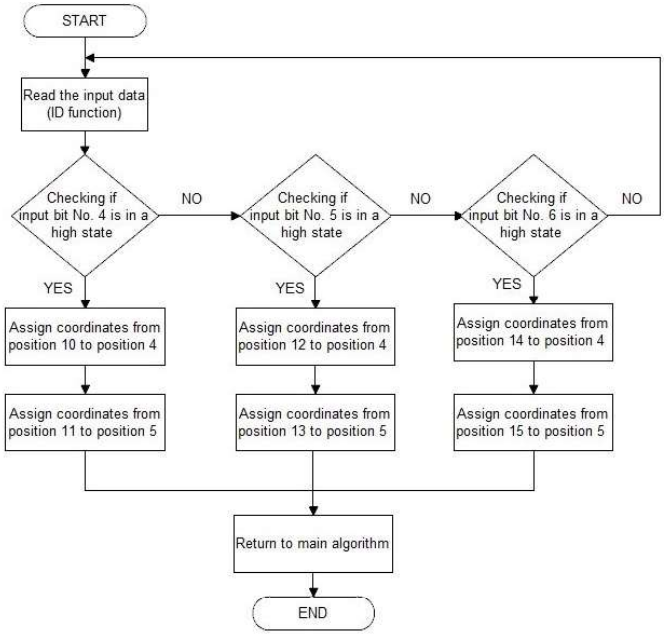

Fig. 7. The fragment of robot's control algorithm – dynamic assignment of the predefined rows coordinates

The position 4 is the location of the robot gripper above the object, while position 5 is the exact place from which the object can be retrieved by closing the gripper. After completing the above steps, the robot's controller continues the realization of the main program.

7. Conclusions

The presented modifications of the laboratory station allowed the implementation of software and hardware integration of the industrial robot with the transport system and remaining equipment of the robotic cell. The basic difficulty in accomplishing this task was the inability to use typical protocols related to industrial networks. Finally, the communication was implemented using binary I/O on the robot and PLC side. Because of many limitations of this solution, the work on the implementation of the RS-232 standard on the PLC side as well as the development of control algorithms along with the use of additional sensors will be continued.

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SELECTED ENGINEERING PROBLEMS
NUMBER 8
DEPARTMENT OF ENGINEERING PROCESSES AUTOMATION
AND INTEGRATED MANUFACTURING SYSTEMS

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A PROJECT OF A TYPICAL PROPORTIONAL AMPLIFIER BASED ON THE ARDUINO PLATFORM

Abstract: In the paper was presented a possibility of application an Arduino controller as a core of a proportional amplifier for the hydraulic proportional valves. The proportional amplifier is an electronic module to drive the proportional valve via energizing the coils of its proportional solenoids. The characteristic features for this type of amplifier are: adjustable nominal current of proportional solenoid, internal feedback loop of the coil current, current offset and correction of the valve deadband. The authors' goal was to implement the basic functions of a typical proportional amplifier due the software method using a cheap Arduino controller. The attempt to use the Arduino controller as basic module of proportional amplifier was a success.

1. Introduction

The main task of article authors was to build a system that will act as proportional amplifier, and will be able to control the current flowing through the coil of proportional solenoid. The value of the current should be proportional to the control signal given by means of the potentiometric adjuster.

The purpose of the work was to create a working proportional amplifier model, based Arduino platform. For this purpose, Arduino Mega microcontroller and additional components (for output amplifier and command signal generator) were used to build the system. After building a working model of amplifier tests were carried out using the program written in C.

2. Arduino platform

Arduino is a programming platform for embedded systems (Figure 1). Intended for microcontrollers mounted in a single printed circuit, with built-in input-output support and standardized programming language. The Arduino programming language is based on the Wiring environment and basically on the C / C ++ language.

The Arduino platform was very well received by electronics enthusiasts. It is easy to use. It can be serve by people who want to carry out projects related to electronics in the future. Arduino controls devices connected to its connectors. It can turn the motor or light on and off. That is why Arduino is often called as a cheap PLC controller.

Fig.1. Arduino Uno as the example hardware element of Arduino platform

Arduino was founded in 2005 at the Institute of Interaction Design in an Italian city Ivrea. Professor Banzi was looking for an economic solution having make it easier for students to contact with a techniques of PLC control. He shared his doubts with David Cuartielles - a visiting researcher from the University of Malmö in Sweden, which was also looking for a similar solution. And that's how it was born Arduino.

The new controller was called Arduino to commemorate the local bar visited by the staff and students of the institute. The controller was sold to students in self-assembly kits. The first series was quickly sold out, so more were produced to meet the demand. Designers of other specialties heard about Arduino and also wished to use it for their projects. Its popularity grew rapidly when more and more creators were convinced that Arduino is an inexpensive and easy-to-use system that can be used in their projects, and that it is a perfect introduction to the world of microcontroller programming. The project has been refined and new versions of the controller have been introduced. The sale of the original Arduino has already exceeded 300,000 and it is offered by numerous distributors around the world.

2.1. Microcontroller of Arduino

The main element of Arduino is the microcontroller. Other elements on the circuit board deal with system power supply or allow the system to communicate with the PC computer. The microcontroller looks like a small computer stored on a board. It has all the elements that the first computers had for human use. Arduino has a processor, Flash, SRAM and EEPROM memories, input and output connectors. All these elements are used to connect the microcontroller with other electronic elements.

Central Processing Unit is the most important element in the construction of a microcontroller. The CPU is responsible for the execution of the program written by user.

Another important element are the memories, differing in the speed of access and data capacity. Other necessary elements are peripheral devices that are used to communicate with the environment. Input / output ports are often used. The data flow between the modules can be seen on Figure 2.

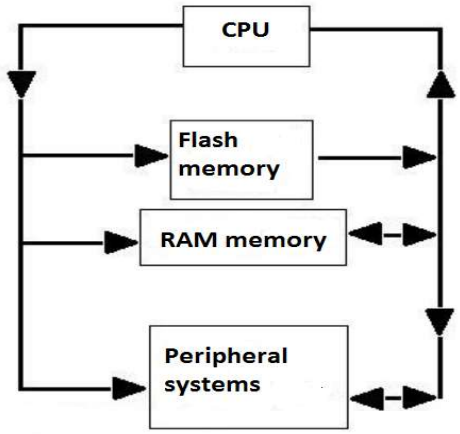

Fig.2. The most important elements of the microcontroller

3. Hardware and software of proportional amplifier based on Arduino

An proportional amplifier is an electronic device that control the value of coil current of proportional solenoid. Amplification of the amplifier is measured as the ratio of the output current and input signal. The form of a prototype proportional amplifier is shown below (Figure 3).

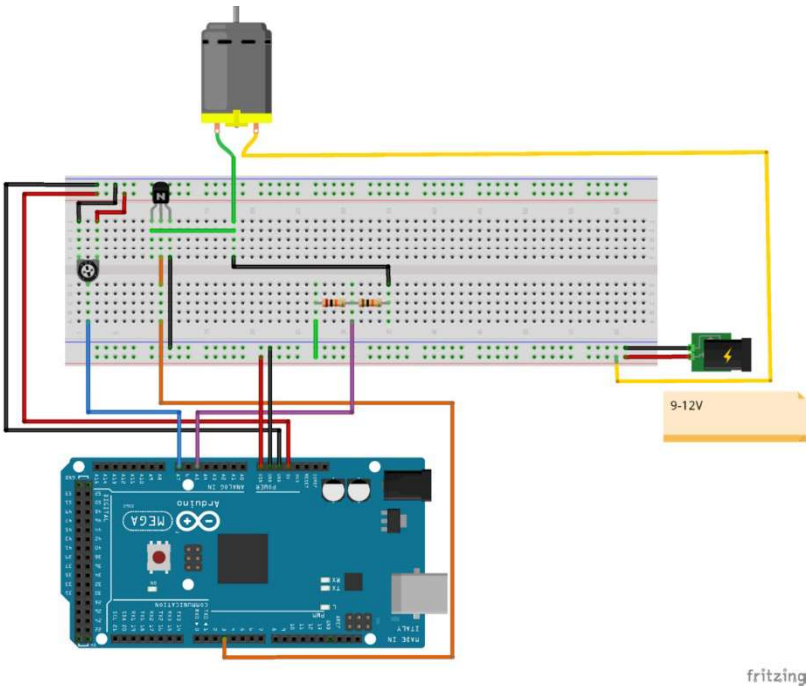

Fig.3. The form of prototype of the proportional amplifier

The project used a program written in C, which is used to implement the function of the PID controller for coil current of the proportional solenoid. The controller compares the set point value for coil current on the input with the output value, and when the error is positive or negative reduces or increases the PWM filling.

The most important variables defined in the above program:

- Setpoint, a value from 0 to 4 based on normalized values with a potentiometric adjuster,
- FeedbackValue voltage value from the measuring system. When using a voltage divider, it takes values from 0 to 4 for a maximum value of 12 V,
- OutputValue value calculated by a function that is part of an external library that meets the PID controller's tasks. The value assigned to this variable is modified on an ongoing basis by algorithms being part of the above-mentioned library in order to obtain the FeedbackValue value as close as possible to the Setpoint variable. Output value is sent to transistor amplifier as PWM signal.

The PWM signal sent to the base of the transistor allows direct voltage control which will be applied at the motor input. The same voltage value after transmission through the voltage divider can be sent without any harm to the microcontroller to one of the analog input ports in order to measure the output voltage.

4. Conclusion

The attempt to use the Arduino controller as a proportional amplifier showed that it is possible and relatively simple.

In order to obtain a fully functional proportional amplifier, the Arduino cotroller alone was not enough. The Arduino module had to be supplemented with a potentiometric adjuster, elements of current feedback loop and the output amplifier.

Tests, which made on real prototype of the proportional amplifier based on Arduino Mega, have shown the correctness of the script written in C. The prototype has fulfilled its task and allowed correct control of the proportional solenoid.

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