SECTION 8

TEACHING AND STAFF TRAINING IN AUTOMATION TECHNOLOGIES

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SOFTWARE-HARDWARE COMPLEX FOR SORTING THE PRODUCTS BY COLOR WITH THE ROBOT MANIPULATOR

Annotation: The article is devoted to the description of the software-hardware complex that we developed and which is designed to sort products according to their color with a robot manipulator. This complex is used in the educational process at the National University of Water and Environmental Engineering.

Key words: robot manipulator, control systems, microcontroller, software-hardware complex

Nowadays one of the key elements of the technical solutions to the problems of complex automation of production is the use of industrial robots (IR). This is due not only to the high speed, accuracy and reliability of the IR, but also to the ability to work in conditions of dangerous and harmful to human production factors. Modern industrial works are complicated software and hardware complexes, the change of the software component which, as a rule, allows them to be adapted to the manufacture of new types of products without additional expenses on the hardware part.

Thanks to the development of information and measurement technologies, IR can not only affect the external environment in a given algorithm or manually in accordance with the task of the operator, but also to change the algorithm of the work depending on the surrounding environment conditions.

The developed software-hardware complex is intended for obtaining practical skills of programming and use of devices of industrial robotics during the trainings for specialists in the field of automation and robotics.

The structure of the Software-hardware complex for sorting the products by color with the robot manipulator is modular and flexible. At the heart of the complex is a manipulator with 6 degrees of freedom and a control system for its movement [1].

The control system has been improved to solve the problem of sorting products, which are moving along the conveyor belt, according to their color.

The complex consists of the following subsystems, which are controlled by the microcontroller board Arduino Mega 2560:
- conveyor belt movement;
- color definition;
- automatic manipulator movement control;
- manual manipulator movement control;
- remote manipulator movement control.

The conveyor belt movement control subsystem works as follows. At the ends of the conveyor there are two sensors of positions. When opening the beam of optocoupler at the beginning of the tape, it provides checking the absence of its movement, and, if necessary, blocking the movement to prevent the falling of the product during loading. After holding at 5s, the movement of the parts through the conveyor continues until the beam of the optocoupler at the end of conveyor interrupts, which is a signal of stopping the conveyor and activating the subsystem of color definition. The total quantity of components sorted and available on the conveyor is controlled by counters.

At the heart of the color definition subsystem is the TSC3200 sensor, which is formed by four sensing elements for red, green, blue colors and light intensity. The measurement of intensity of each individual color duration is 10 ms. As the result, we have an RBG-color ratio every 40 ms.

After determining the color, the product is moved by the manipulator according to the corresponding algorithm. For moving the parts of the manipulator in each of its kinematics pairs a servo drive of the direct current MG996R is installed with the possibility of changing the position of the output shaft from 0 to 180 °. The control of the positions of each of the servo drives is carried out by supplying from the discrete outputs of the Arduino control board with pulse-width modulation at a frequency of 50 Hz.

The microcontroller board is connected to a personal computer using a USB cable. This provides the ability to quickly reprogram the microcontroller, if necessary, to debug the program and control the manipulator from a convenient graphical interface.

For remote control subsystem we use wireless Bluetooth connection of the Arduino board with Android handled device with additional application installed on it. It gives us an additional advantage to show our students, how to develop remote motion control software.

The developed complex helps students to get in touch with the modern industrial equipment, such as industrial robotics from both, software and hardware sides, improve. Technologies, which are used here, shows students how to combine different kinds of technologies and make them working together in complex. The flexibility of all part of developed complex also gives an opportunity to improve it with different additional modules in future.

References

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