UDC 004.896

Vitalii Kutia, Anton Shablovskyy, Alla Shablovska (Rivne, Ukraine)

SOFTWARE DEVELOPMENT FOR ROBOTIC ARM REMOTE CONTROL

The industrial robots (IR) are among the main components of modern computer-aided manufacturing equipment. The fast reconfiguration ability for the execution of various technological operations distinguishes them from the other automation tools. An IR has a manipulator with a gripper or an operating tool: screwdriver, spray gun, welder and so on. Thus, the IR can be used to perform the variety of production tasks: welding, painting, folding, displacement, assortment, parts transportations etc. So, modern industrial robots are very advanced machines used in the industrial manufacturing sector and also have many other specialized applications [1].

The aim of this work is to develop the software for remote control of the educational robotic arm. Educational robotic arms are a good alternative to industrial manipulators to be used in university courses because they are much cheaper than real IR and are built by the similar kinematics structure. The developed software will be useful for young specialists' training in the field of industrial automation and robotics.

The studied robotic arm has 5 degrees of freedom (DOF) represented by respective rotational joints: robot base, shoulder, elbow, wrist, gripper rotation. There are 5 DC servo drives installed in every joint and additional one is used for gripper movement. The servo drives are connected to power source and control system [2]. The control system is based on Arduino Mega 2560 microcontroller board.

The microcontroller board Arduino Mega 2560 is connected to PC with the USB cable. It makes possible the microcontroller quick reprogramming ability (when debugging is needed) and control of the robotic arm movements from PC with an easy-to-use graphic interface. The Bluetooth module HC-05 is connected to the Arduino board to make possible a remote control of the robotic arm.

The software of the robot control system consists of the Arduino board program, Windows-compatible application for PC and the application for Android devices.

The PC application is written in C# using MS Visual Studio 2013 and software platform Microsoft .Net Framework 4.5. The Arduino board connection settings are accessible from the main window of the application: the COM-port number and baud rate. A successful connection enables an access to the 6 horizontal scroll bars. The rotation angle value (joint angle) of every servomotor can be set using these scroll bars. The joint angles are being sent to the Arduino board via the serial port and then the Arduino sends control pulses to the servo drives.

Both command and program control modes of the robotic arm can be implemented using the developed software. The command control mode has an ability to change separately the default position of every servomotor from PC. This mode is used as the extra control mode e.g., for the programming of the robotic arm via the instructional method. The servomotors work sequentially in command control mode. The operating speed of this mode is not high since the path velocity of the servo drive shaft is decreased for the required position accuracy ensuring.

Remote control of the robotic arm was achieved by creating the Android-based mobile application. This application was developed using software platform Google Android SDK and written with Java programming language in Android Studio IDE. The mobile app makes it possible to control the robotic arm movements using the Bluetooth connection between the Arduino board and the Android device. This application also has the same functionality as the PC application.

The developed software can be used in robotics and mechatronics courses. A very important aspect of the developed applications is access to source code, which allows students to learn and discover different techniques of manipulators control.

References

1. Pires J. N. Industrial Robot Programming / J. Norberto Pires. – Springer, 2007. – 282 p.
2. Кутя В. М. Програмно-технічна реалізація системи керування роботом-маніпулятором / В. М. Кутя, А. О. Шабловський // Інтегровані інтелектуальні робототехнічні комплекси (ІІРТК-2015). Восьма міжнародна науково-практична конф. 18-19 травня 2015 р., Київ, Україна. – К.: НАУ, 2015. – С. 206–207.