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MECHANOTRONIC ROBOTIC DEVICE FOR PRODUCTION OBJECTS RECOGNITION

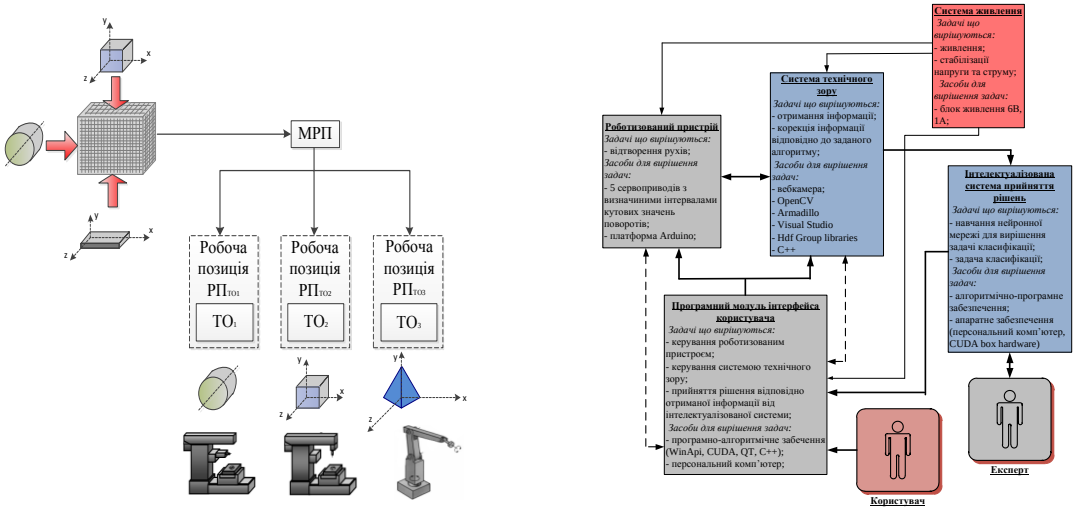
The rapid development of modern production requires the use of flexible, interchangeable systems, called flexible manufacturing systems (FMS). FMS are based on industrial robots (PR), which are designed to manipulate production objects (PO). Manipulation operations require previous recognition and spatial orientation, such as streamlining production environment. It is a difficult and time-consuming process. One of the ways to solve these types of problems is the use of robotics, mechatronics, and microprocessor technologies. The solution is based on the idea of mechanical, electronic and computerized elements interconnection. It allows us to create and exploit new mechatronic robotic devices (MRD) which are the basic elements of PR. Mechatronic module is a functionally and structurally independent unit aimed at automating the processes of PO recognition and manipulation.

To implement PO manipulation it is better to use MRD with algorithmic software.It can select from a plurality of separate production facilities, determine its location, grasp and transfer the PO in a given place. Because of a universality of MRD created on the basis of their flexible production systems we can achieve relatively high rates of flexibility and opportunities to process new products.

Building the MRD model for object recognition involves the production of functional interaction of production facilities and elements of MRD that can be the basis of the informational, software and technical support of developed MRD. For example, MRD for PO recognition can be designed as a functional sequence of automated modules, which are connected by information channels. Graphical interpretation of its functioning is in Fig. 1, a. MRD should recognize PO type(cylindrical, prismatic or pyramid), and move it in to their special places (Fig. 1,a). Organization structure of MRD for PR recognition is in Fig. 1,b.

The autovision system of MRD is based on artificial neuron networks (ANN). It takes input information about PO from webcam and transfers it as pixel matrix 160x120.These pixels are passed as input information for ANN.

According to the image dimensions, the input layer size consists of 19200 neurons. ANN output layer is formed accordion to the number of analyzed PO groups. According to the output group size output layer consist of 3 neurons. The size of the hidden layer is 10 neurons and it has been determined experimentally. ANN architecture is based on a multi-layer perceptron with back propagation. ANN structure is shown in Fig. 2.



a b

Fig. 1.Organization and functional structure of MRD

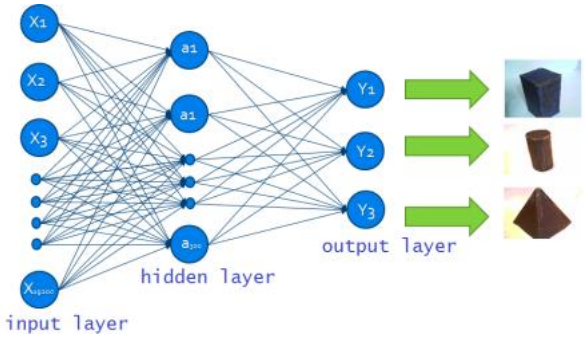


Fig. 2. ANN structure Fig. 3. MRD exterior

Software for manipulation and robotic device movement is implemented via Arduino IDE in C++-like language. ANN is built via Octave in MATLAB language. Graphic user interface is developed using Qt5.3 library in C++. To exchange information between modules MRD uses international standard HDF5. 5. MRD exterior is shown in Fig. 3.

A number of experimental studies confirmed the efficiency of MRD to detect PO and its suitability for use in the laboratory.