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Reconfigurable FPGA Application for RT Control of Industrial Robot

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Abstract This paper analyzes a complex scenario of using the Compact-RIO embedded system to control flexible real-time processes in industrial environment [1]. The described application is around intelligent control path, a very suitable field for the characteristics of the mentioned system.
Moreover, the paper gives details about the control algorithm, the testing procedures, including the measurements and the results obtained with a MyRio 1900 module implemented on a robot arm with two servomotors (actuators).
The first part presents the MyRio development system with its sensors and actuators. Also, the configuration and programming procedures are clarified in this section.
The second part presents the set-up of the stand and the experiments carried out for an application regarding the precise handling of components in the medical area.

Motivation

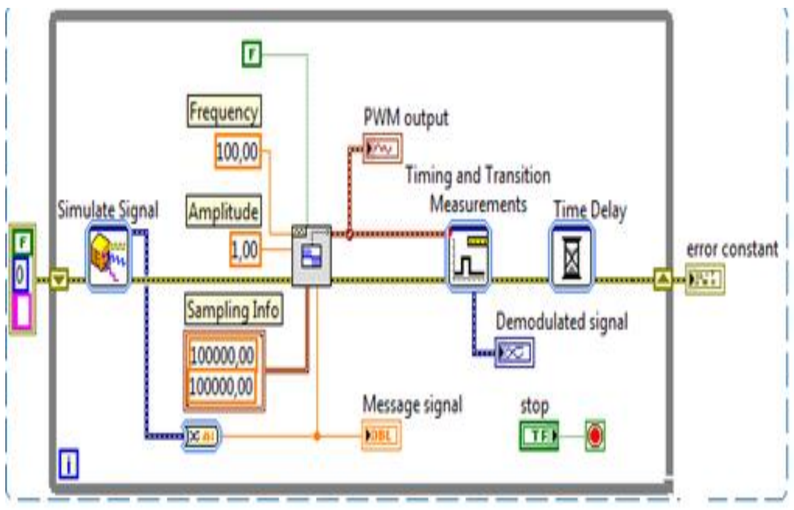
For the developing of the experimental prototype and to provide the basic measurements and the compliance tests, is proposed to use a MyRio 1900 module The implementation of the computing architectures, data acquisition and processing systems and VLSI integrated circuits on a single compact board, has an upward trend in the industry due to the advantages that these FPGA circuits have in comparison with µC- or ASIC-based circuits.

The advantages of using the MyRio module are numerous, but in particular, through the friendly programming in the LabVIEW graphical programming environment, there is the possibility of remote control, including the easy change of the execution program.

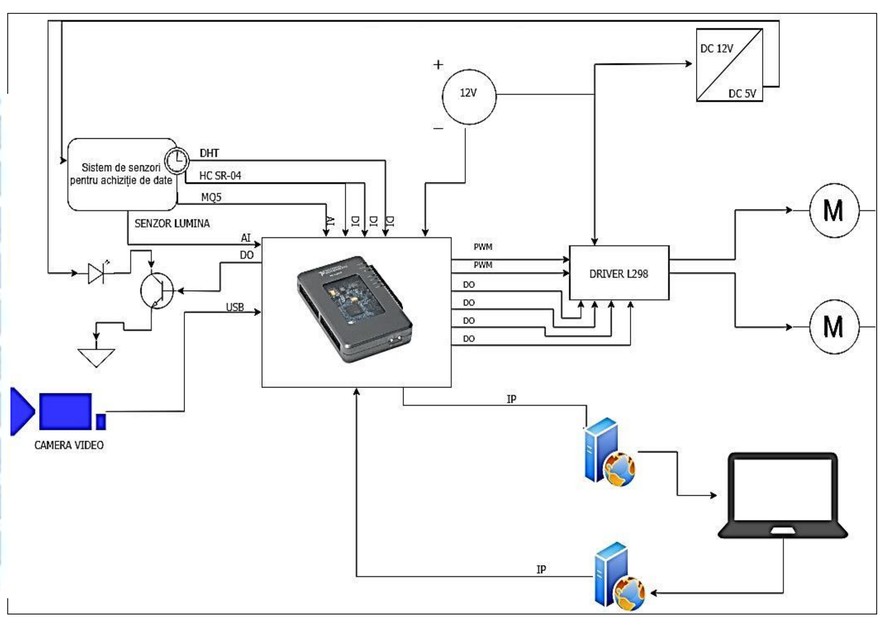
Prototype development

The device has 3 ports, including 2 identical ports labeled A and B each with 34 pins and an additional port C with 20 pins. Analog or digital sensors can be connected to them, a video camera for live image transmission or for detailed optical analysis of the handled parts. To control the drive motors the MyRio has dedicated pins as input for the encoder and also as output for PWM signal. The encoder used in the practical experiments was a rotary encoder ROD 426 produced by the Heidenhain company.

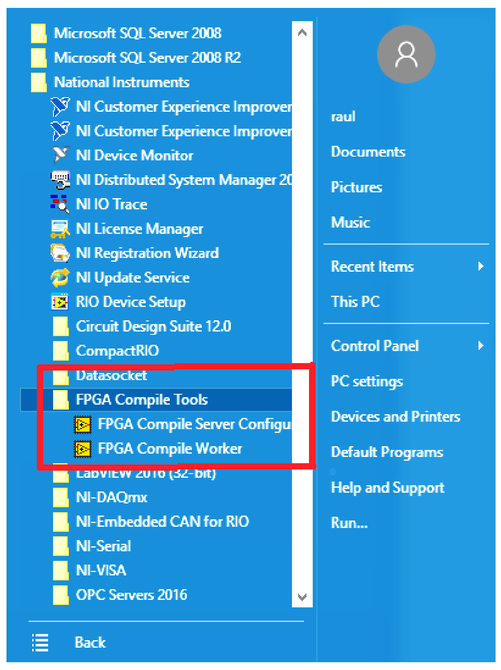
Xilinx FPGA programming is usually done in hardware languages such as VHDL or VERILOG. In order to be able to program the FPGA device with the LabView IDE, a Xilinx-made compiler was needed; more specifically the Vivado compiler version 2015.4 was used.



Variables and constants setting



Block diagram of the object handler implementation

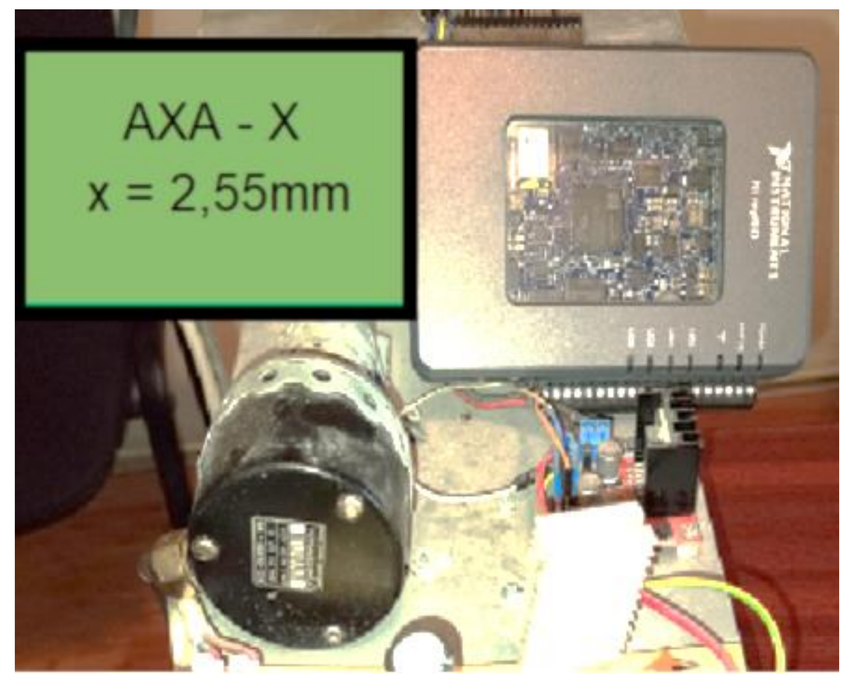


Xilinx compilator in LabView Env.

Experiments and Conclusions

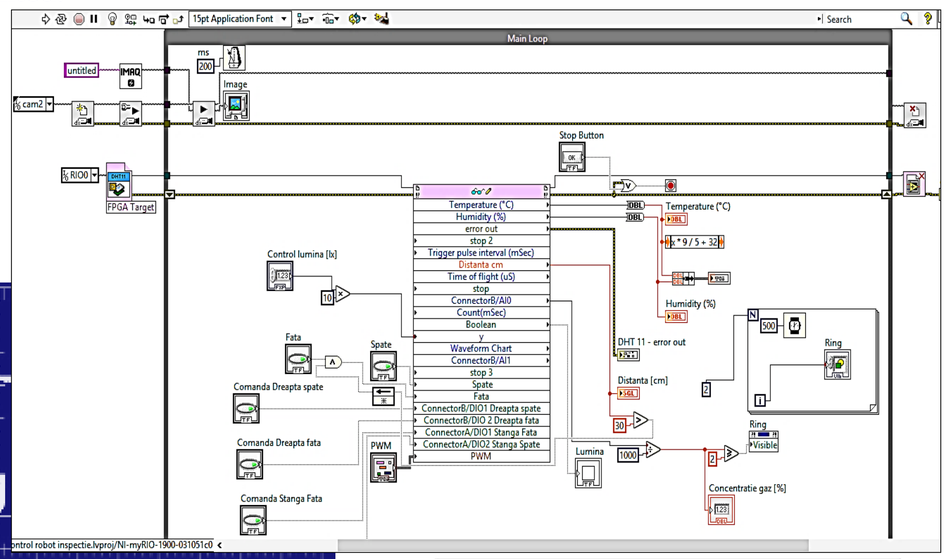
Following the experiments applied to one channel motor control, we switched to two-axis control. For practical implementation, a video camera used to make commands to select objects depending on the reading of a barcode, QR code or color has been integrated. The control of industrial robots is done by running the execution program on a PLC-module. The implementation of a movement operation is usually followed by the implementation of a dimensional, shape, color control operation or according to other characteristics imposed on the handled or manufactured product.

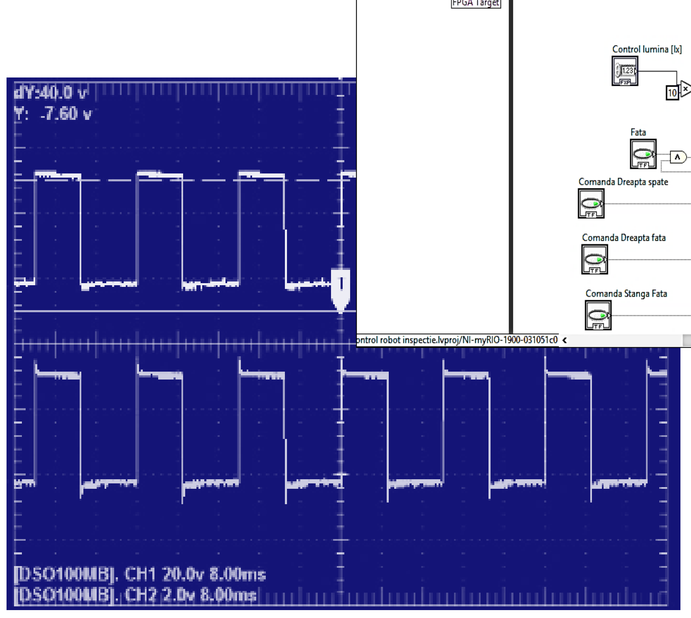
Starting from the facilities offered by the MyRio platform, it is planned to use them in the future for the control tasks, so that with the same device both the robot control and the quality control can be simultaneously implemented.



Test bench with MyRio module

Main program and pwm chanel





Pwm output signals

Literature

[1] Ed. Doring „NI myRIO Project Essentials Guide" – National Instruments 2016
[2] I. Lita, D.A. Visan, A.G. Mazare, L.M. Ionescu, A.I. Lita "Automation Module for Precision Irrigation Systems", IEEE SIITME-Conference 2020, Pitești, Romania.
[3] S. Sarkar & Co. "Acquisition and pre-processing of three phase induction motor stator current signal for fault diagnosis using FPGA, NI Compact-RIO real time controller" IEEE UPCON Conference 2016.
[4] M.L.Derouiche, S.Bouallègue, J.Haggège, G.Sandou, "Rapid Model Predictive Control prototyping with LabVIEW/CDSim and Compact RIO target". CEIT Conference 2016