# RESEARCH ON THE CONSTRUCTION AND DEVELOPMENT OF A PICK AND PLACE ROBOT

OPRICĂ Corina-Roxana[1], GHIONEA Gabriel Ionuț[2], JUGRAVU Bogdan-Alexandru[2]
[1]Faculty of Industrial Engineering and Robotics; Specialization: Applied Computer Science; Year of study: IV;
e-mail: roxana.oprica@yahoo.com
[2]Faculty of Industrial Engineering and Robotics, Manufacturing Engineering Department, University POLITEHNICA

*ABSTRACT: The introduction of automation into the industry can provide operational efficiencies and low costs in many areas of it but navigating the path form concept demonstration to successful expansion can be a complex task and can be challenging. The paper presented is the result of research conducted in order to develop an efficient and innovative palletizing system.*

*KEY WORDS: robotic arm, Arduino, Labview, palletizing, industry.*

## 1. Introduction

The aim is to develop an experimental model of a pick and place robotic arm for handling and placing products. The system consists of an articulated robotic arm, a conveyor for transporting the products, a support for the products to be taken over by the effector and a storage shelf for the handled products.

The purpose of the entire system is to streamline the palletizing process.

## 2. The current stage

By definition, a robotic arm means a type of mechanical arm, usually programmable, that has functions similar to those of a human arm. Such an arm can stand on its own or be a part of a larger robot.

The connections for this type of mechanism are made through the joints, thus allowing the rotational movement (for the articulated robotic arms), or they move linearly, allowing the translational movement. It can be said that these arm connections form a kinematic chain. At the end of the manipulator is a final effector that is analogous to a human hand.

Pick and place robots are usually mounted on stable supports, positioned so that they reach different designated areas for work. They have integrated advanced vision systems to recognize, capture and move objects to different locations.

To make this paper, test and simulations were performed using the LabVIEW programming environment.

## 3. System's structure

The main component of the test is the *NI 9237* module [1], which was used to calibrate a force cell. The module can be used in a wide range of applications at industrial level, such as applications for measurement, control and communications. This input module works using *NI-DAQmx* 8.1 or later software.

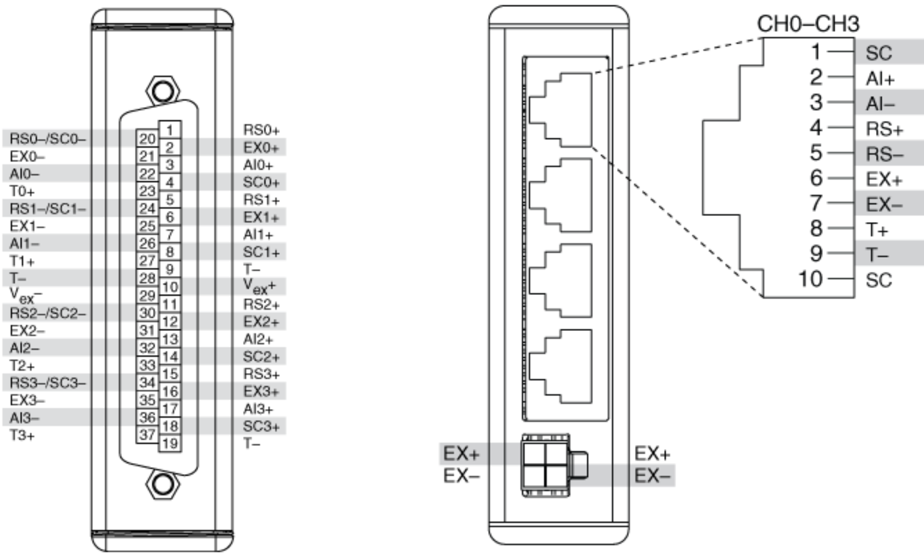


Fig. 1. NI 9237 module

Tehnical specifications:

- Resolution: 24 bit
- Connectivity: D-Sub or RJ-50
- Channels: 4
- Sample rate: 50kS/s
- Frequency: 12.8 MHz

Another component with which the movement was made is the *NEMA 23* stepper motor [2]. It is a hybrid bipolar stepper motor that is generally used in CNC machines, 3D printers, pick and place machines or linear actuators. This motor can be controlled by two H bridges, but it is recommended to use a stepper motor driver.

The first coil is formed with black and green wires, and the second coil is formed with red and blue wires.

Tehnical specifications:

- Voltage rating: 3.2V
- Current rating: 2.8A
- Step angle: 1.8°
- Steps per revolution: 200
- No. of phases: 2
- Holding torque: 19kg-cm
- Width: 56.4mm
- Length: 56.4mm
- Height: 76mm
- Shaft diameter: 3.8mm
- No. of leads: 4

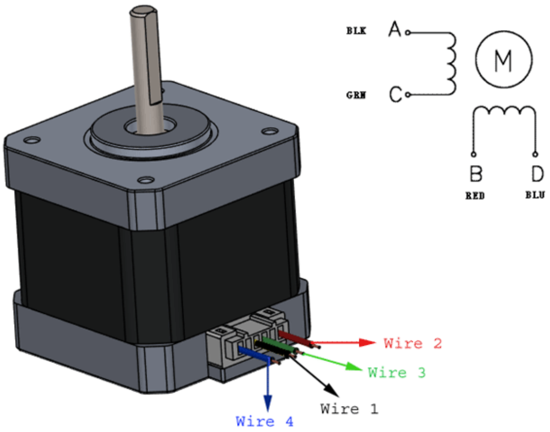


Fig.2. NEMA 23 stepper motor

Calibration was performed using a force cell [3]. This is basically a transducer that turns the force into a measurable electrical output.

A weight sensor works by converting mechanical force into digital values that the user can read and record.

The internal operation of such a sensor differs depending on its type. There are hydraulic, pneumatic or extensometer weight sensors. The ones with the extensometer are among the most used, and the extensometer inside such a sensor transmits voltage irregularities when under load.

Tehnical specifications:

- Maximum load: 1kg
- Excitation voltage: 5V (max 10V DC)
- Output signal: 1 ± 0.15mV/V
- Mounting holes: 4 x M4
- Weight: 27g
- Dimensions: 12.7mm x 12.7mm x 75mm
- Connectivity:
    - Excitation voltage + : red
    - Excitation voltage - : black
    - Signal + : green
    - Signal - : white

Fig.3 Force cell

For the data acquisition we used the Arduino Mega development board, based on the Atmega 2560 microcontroller. It has 54 digital input / output pins, 15 of which can be used as PWM outputs, 16 analog inputs, 4 UARTs (hardware serial ports), USB connection, 16 MHz crystal oscillator, power plug, header ICSP and reset button.

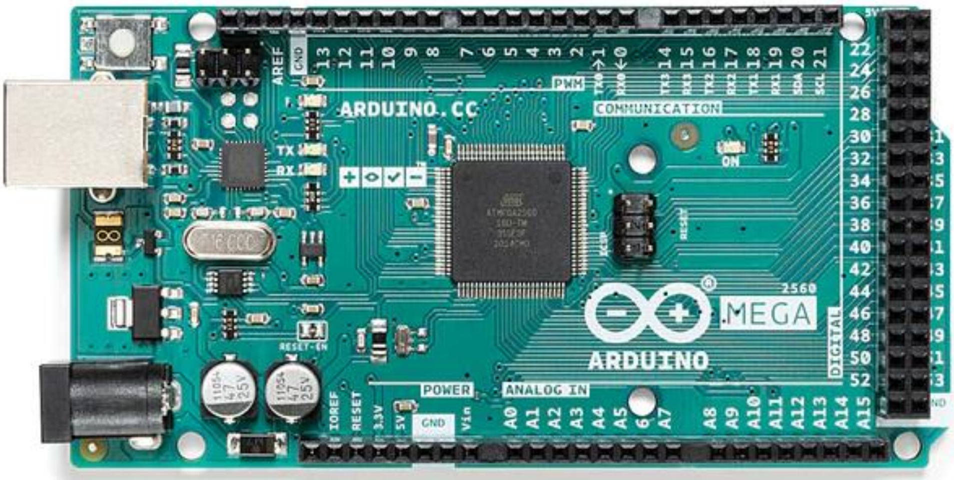


Fig. 4. Arduino Mega

Tehnical specifications:

- Operating voltage: 5V
- Input voltage: 7 – 9V
- DC current per I/O pin: 40mA
- DC current for 3.3V pin: 50mA
- Flash memory: 256KB
- Frequency: 16MHz

## 4. Development of the testing program

The purpose of this program is to start / stop the stepper motor depending on the mass applied to the force cell.

The first step in developing the program was to calibrate the force sensor using the *NI MAX* module of the LabVIEW program, by adding values of some masses.

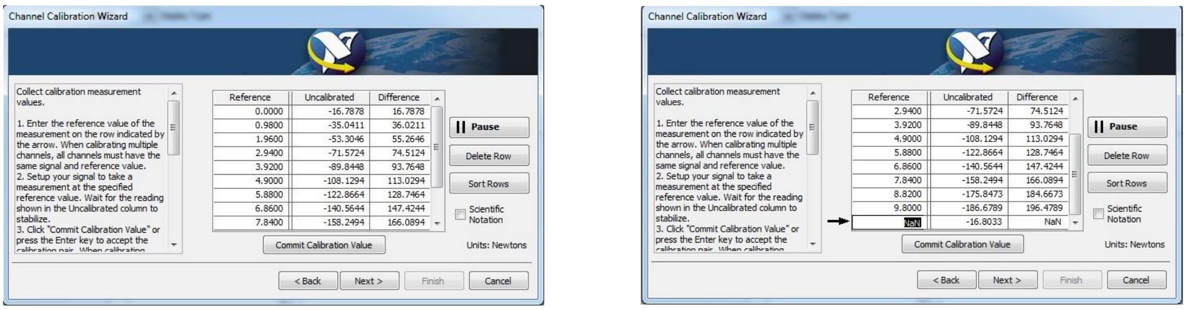


Fig. 5. Force sensor calibration

After this step, the actual programming is made in the LabVIEW software.

Reading and displaying of the mass applied to the force sensor is done through the functions in the *DAQmx* module.

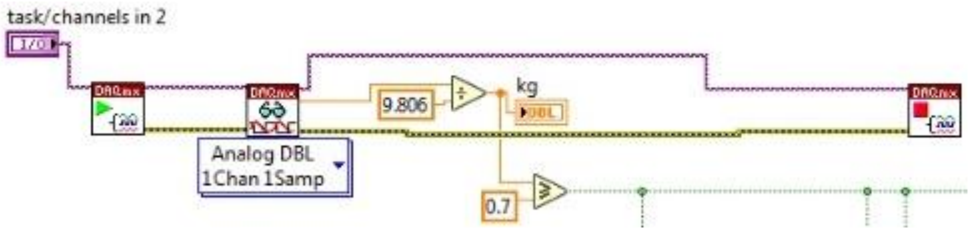


Fig. 6. Reading and displaying the mass

To manage the starting and stopping of the engine according to the mass applied to the sensor, we used the functions in the *Linx* module.

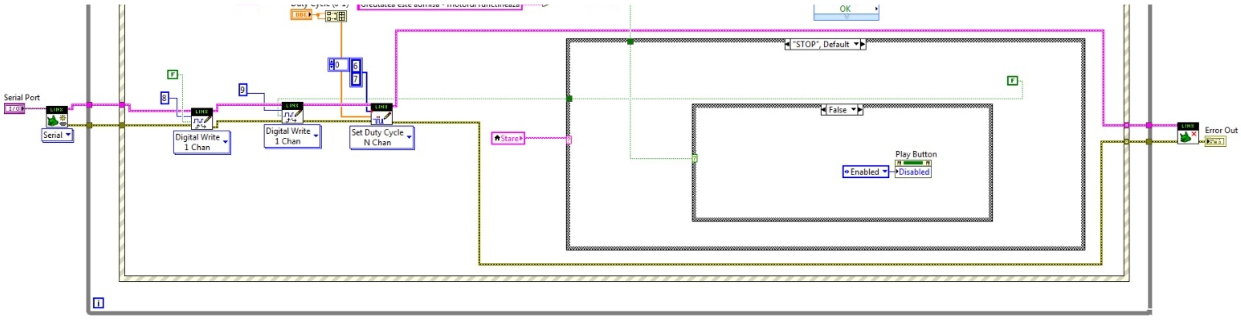

Fig. 7. Starting / stopping the motor

The motor has been connected to the Arduino Mega development board, and above you can see the pins on which the operting directions of the motor and the output of the PWM signal are given.

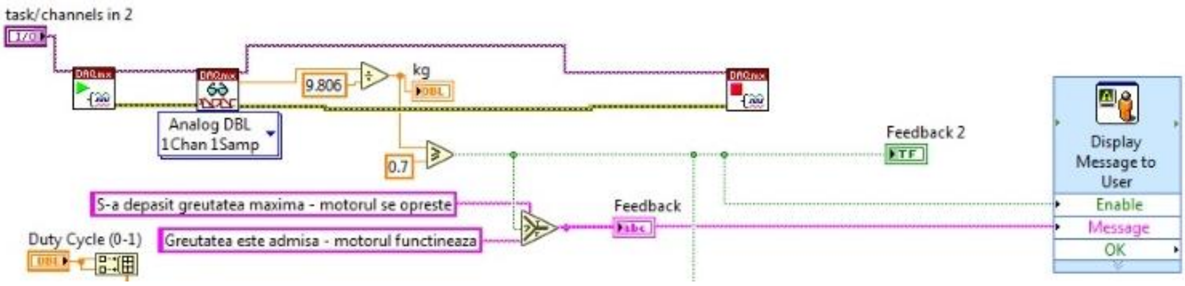


Fig. 8. Setting the start / stop condition

By setting the condition show in the figure above and the *Case structures* used, the engine starts if the mass is <=0.7kg and stops if it exceeds 0.7kg.


Fig. 9. Warning message

If the weight is not allowed, a warning message will also be displayed when the engine will stop. The full program is shown in the picture below:

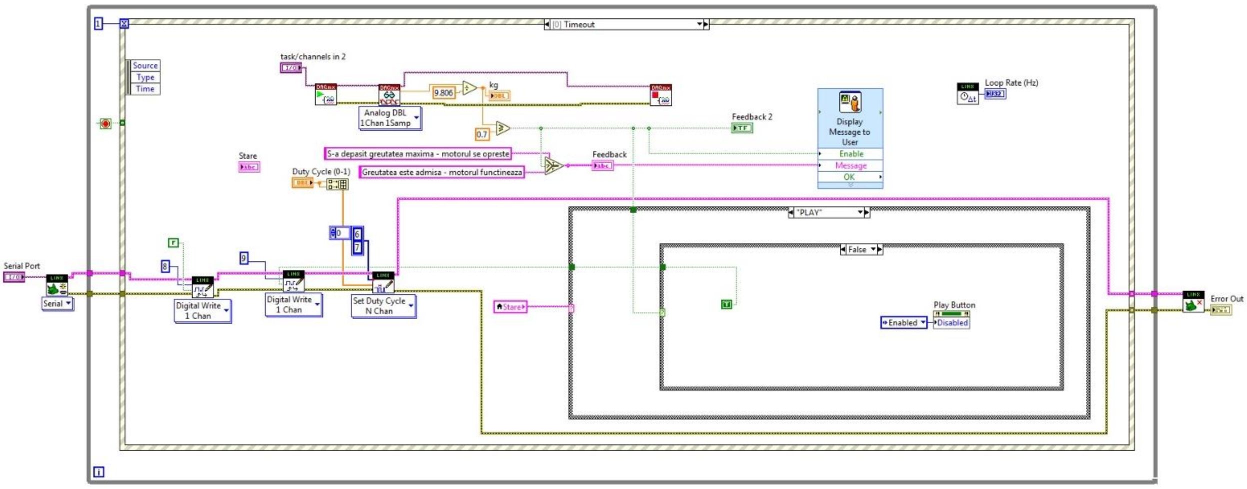


Fig. 10. Testing program

## 5. Conclusion

Through the research carried out on the basis of the sources specified in the paper, of the selected components and by carrying out the program necessary for the tests, we obtained a part of the system that will contribute to the automation of a pick and place robotic arm.

For future developments we have taken into account the simulation of the movement of the axes necessary for the palletizing process and the introduction of other sensors for a better accuracy of the movements.

## 6. Bibliography


[1]. https://www.ni.com/ro-ro/support/model.ni-9237.html

[2]. https://components101.com/motors/nema-23-stepper-motor-datasheet-specs

[3].https://ardushop.ro/ro/electronica/247-senzor-greutate-1kg.html?gclid=Cj0KCQjwl7qSBhD-ARIsACvV1X1kekDjmGI3aYiR8CLYktPIp99BEX54rbiZdGv_SoR2tBS75QUEoXwaAq9hEALw_wcB

[4]. http://store.arduino.cc/products/arduino-mega-2560-rev3

[5].https://6river.com/what-is-a-pick-and-place-robot/#:~:text=Pick%20and%20place%20automation%20speeds,focus%20on%20more%20complex%20work.

[6]. https://robotics.kawasaki.com/ja1/xyz/en/1804-03/

[7]. Savu, T., (2022), Course notes, PUB.