MONITORING AND REMOTE CONTROL, BY IOT, OF A HYDRAULIC PRESS

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ABSTRACT: The following paper will present the process of software development for hydraulic press monitoring and control. Also, it will present the components belonging to the system, the wiring diagram, and the operational scheme that the user will use to control the press.

KEYWORDS: LabVIEW, IoT, Hydraulic press.

1. Introduction

Hydraulics is a science that has the property of studying the laws of motion and equilibrium of various liquids. In its applications, hydraulics is used to generate, control and transmit energy by using pressurized liquids.

Pascal's principle states that when pressure is applied to a closed liquid, there is a change in pressure in the liquid. For a hydraulic press, the pressure in a liquid is applied by a piston that acts as a pump to create mechanical force. [1]

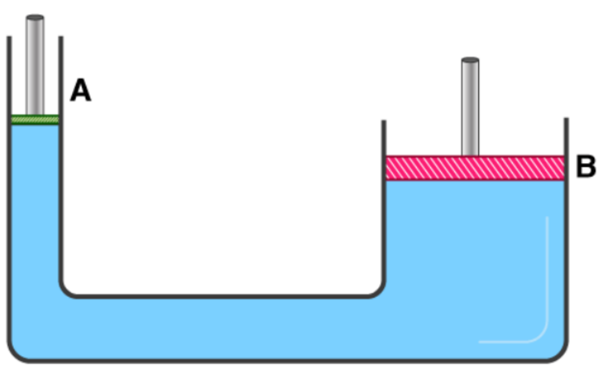

Fig 1. Illustration for Pascal's principle [2]

A hydraulic press is a mechanical device that uses the static pressure of a liquid, as defined by Pascal's principle, to shape, deform, and configure various types of metals, plastics, rubber, and wood.

The mechanism of a hydraulic press consists of a main frame, feeding system and controls.

Thus, the paper aims to create a platform easily accessible to a user who will be able to log in with a username and password, so that access is allowed only to authorized and trained people to work with a hydraulic press. [3]

Once connected, the user will be able to remotely monitor data on the hydraulic fluid pressure, the temperature of the heated press tray, but there will also be the possibility to see a live session in the press room and to control the movements of the hydraulic cylinders.

2. Description of the press

The press on which remote monitoring and control is desired is a two-cylinder workshop press for 75tf heated plate press (tons of force) from the manufacturer Hidromold Hydraulic Power Equipment model PA-75.150.R.00.

Fig 2. Descriptive image for press PA-75.150.R.00. [4]

The press assembly consists of the press chassis with the heated plate and the hydraulic cylinders, the hydraulic drive unit, the electrical connection panel and the manual control panel of the press.

The lower cylinder of the press has as specifications a pressing force of up to 30 tf. The upper cylinder has a pressing force of 75 tf.The hydraulic fluid communicates from the hydraulic pump to the hydraulic cylinders through a complex hydraulic path consisting of hydraulic distributors, pressure gauges, safety valves and hydraulic hoses.

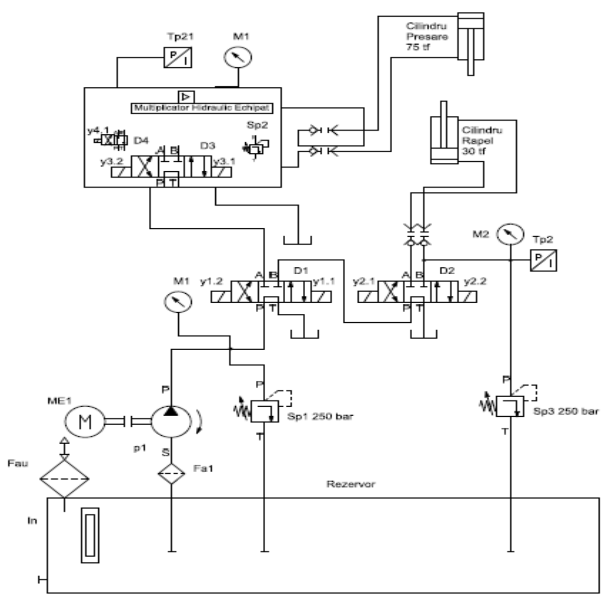

Fig 3. Schematic of the hydraulic route [4]

The electrical connection part between the electrical connection panel and the rest of the electrical components included in the system has now been completed.

The press did not work manually in the early stages of the project because the documentation of the press on the electrical part to be connected by the customer was erroneous, but also the electrical connections made by the manufacturer in the panel were made incorrectly.

So, the first step in going through the chosen project was to identify each component of the electrical connection panel and learn how it works in order to determine if the way it was connected is correct or wrong.

The following incorrect connections were discovered:

-The phases of the three-phase motor of the hydraulic pump were connected in the wrong order and caused the pump to rotate in the opposite direction, failing to send the hydraulic fluid into the system.

-The hydraulic distributors were not connected to the corresponding relays and did not open in the correct order for the press to operate.

-The PLC output wires for the analog signal that was to reach the acquisition board had common connections between the 12V power supply part and the ground part, causing the wires to heat up and the whole system to go into failure and requiring restart it.

-Reversing the connections of the pressure sensors with those for temperature.

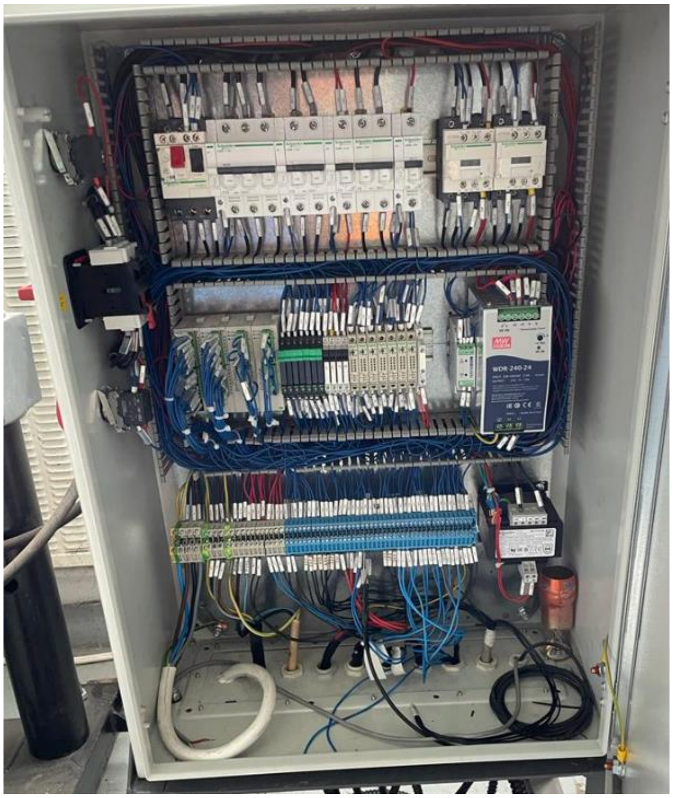

Fig 4. Electrical connection panel following rectifications

3. Development of the LabVIEW program

After the test and the correct operation of the press in the manual operation mode were ensured, I started to identify the dedicated cables for the operation of the cylinders and sensors with the help of the acquisition board.

Therefore, we have used the instructions for connecting to the purchasing board provided by the supplier.

Cablu de legatura placa achizitii presa:
1. Firul cu tila 255→ pump ON / OFF command
2. Firul cu tila 256→ heating ON / OFF control
3. Firul cu tila 261→ upper cylinder selection command
4. Firul cu tila 262→ lower cylinder selection command
5. Firul cu tila 263→ cylinder advance control
6. Firul cu tila 264→ cylinder retracted control
7. Firul cu tila 271→ press command
8. Firul cu tila 371→ signal 0 ÷ 10V → upper cylinder force value in [KN]
9. Firul cu tila 372→ signal 0 ÷ 10V → lower cylinder force value in [KN]
10.Firul cu tila 381→ signal 0 ÷ 10V → plate temperature value in [° C]
11.Firul cu tila 152→ it will be connected to the minus of the source that feeds the acquisition board.

Fig 5. Plug-in connections. [4]

This is how the LabVIEW program for computer operation was developed.

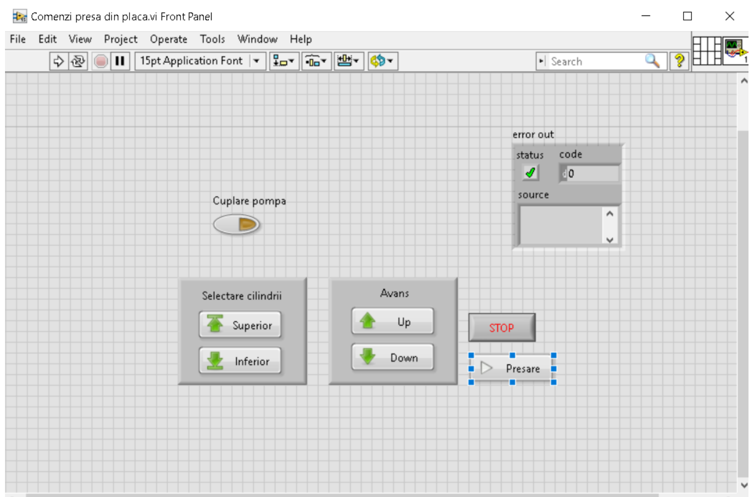

Fig 6. Application front panel.

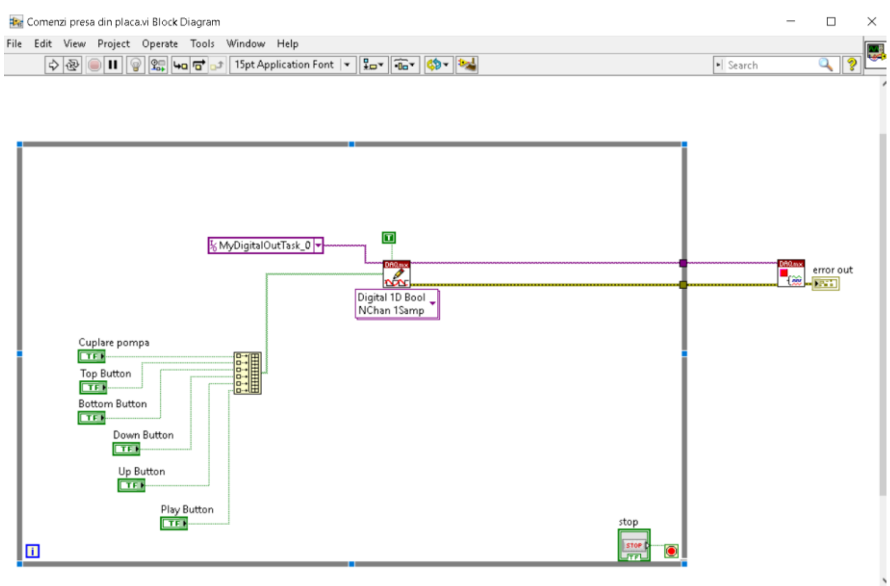

Fig 7. Block Diagram of the application.

4. Future implementations

Furthermore, the LabVIEW program will be assigned functions for displaying the pressure in the two cylinders but also for displaying the temperature in the heated plate.

A website will be created with a username and password but also with buttons that will be operated by a user to control the press.

At the same time, a web service will be available to connect the dedicated site with the press, this web service will run on a local station near the press.

5. Forecasts regarding the press

After the completion of the remote action and monitoring project, taking into account that the press is in the possession of the faculty, it will have a didactic and demonstrative role, but I think it would have a stronger impact on students and would arouse more interest if they could control the press even from their mobile devices: laptops, tablets, phones, etc. and could view the results even remotely.

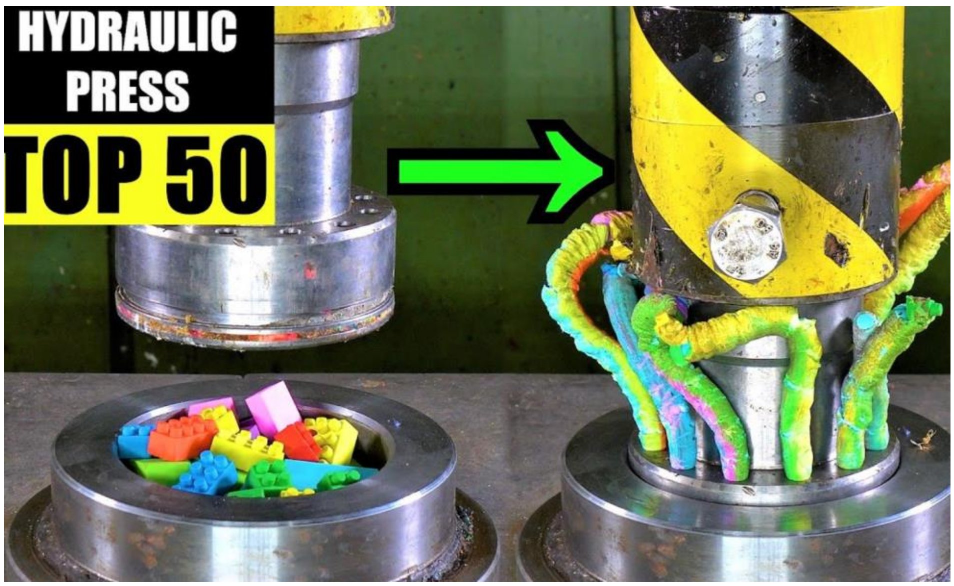

Fig 8. Idea for interactive teaching material. [5]

6. References

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