

Slow Control System

Definition: the purpose, functionality;

Design: hardware, software, bookware;

Example implementation: BM@N; MPD-NICA



JOINT INSTITUTE
FOR NUCLEAR RESEARCH

Study of energy emitted from a detector by measuring its temperature

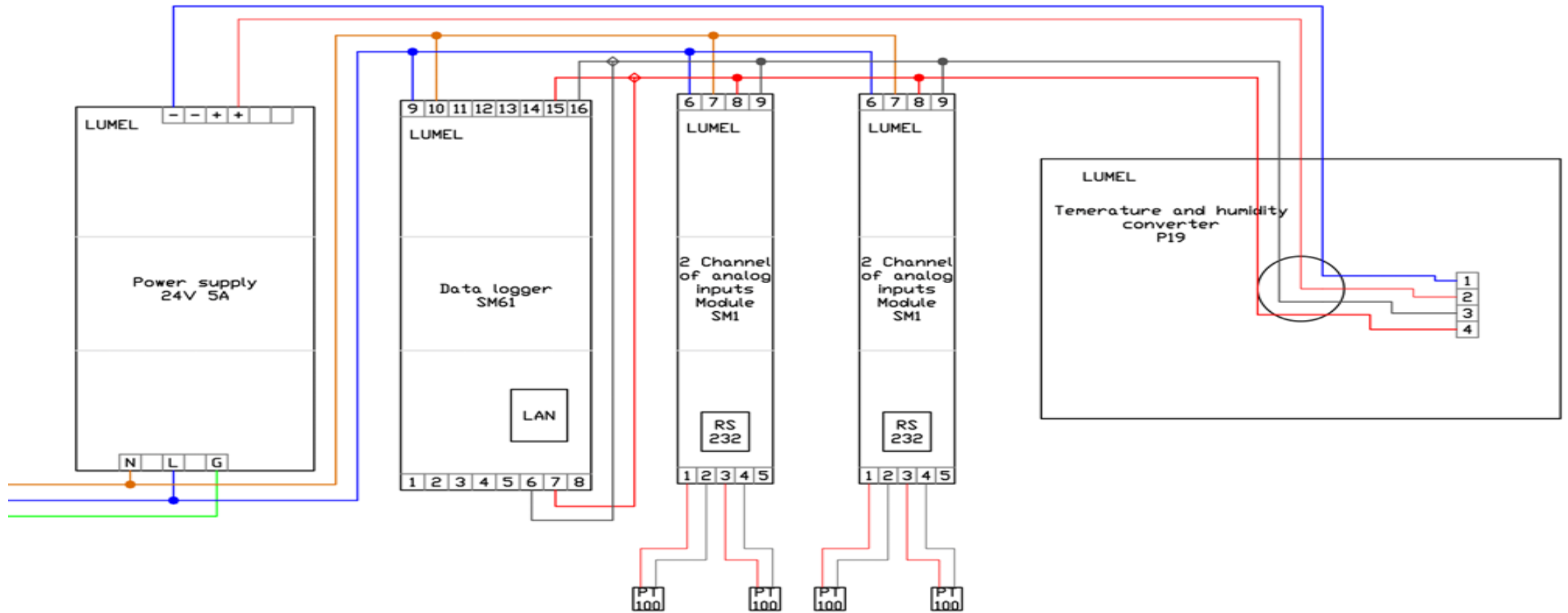
I.Dusza, P.Antkowiak, P.Rybak
Warsaw University of Technology



Goal of the project



Devices



Assembled layout






Data Recorder SM61 setup

Data logger SM61

Administration ▶ Restart device Reload page

Channels - configuration

Editing channel number 1

Channel mode Full ▼

Source type Modbus RS ▼ ?

Modbus function number 3 ▼

Device address 253

Base register address 7500 ?

Register size 32b ▼ ?

Registers type float4321 ▼



Polling interval 5 s

Archiving interval 10 s

Device timeout 1000 ms

Zapisz zmiany po raz pierwszy

Adres przypisany do urządzenia

 Add next |  Delete last

Value number	Name	Register address	Unit	Mathematical operations		Operations with other channels			
				Mathematical operator	Argument	Mathematical operator	Channel number	Value number	
1		7500	▼	▼		▼			
2	Temp_by_P19	7501	°C ▼	▼		▼			
3	Air_humidity	7502	% ▼	▼		▼			

Labview settings

IP Address: 192.168.1.1 Port: 502 stop STOP

Connection status

status: error code: d0 source: []

Overview Calibrate **Settings**

Set name, unit of measurement and address of register you want to add. Click ADD to confirm.

Name: PT100_3

Unit: *C

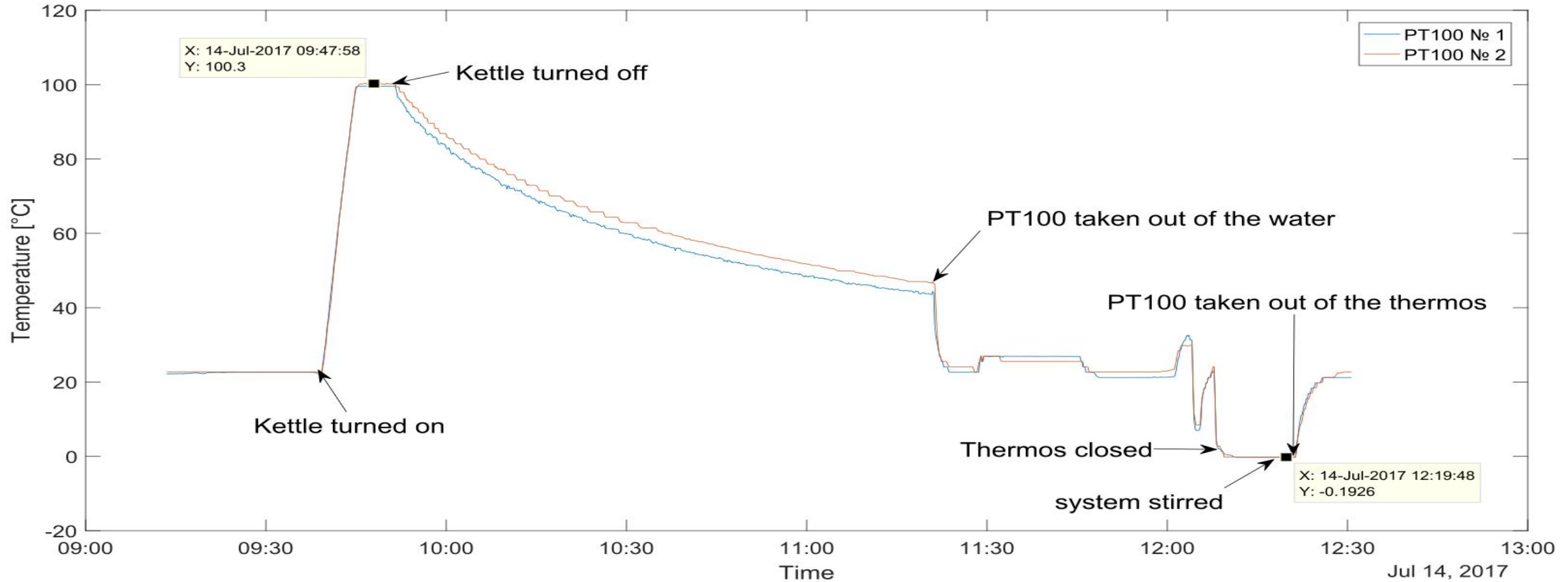
Register address: 8022

ADD

Here you can check currently configured devices and parameters of calibration for selected device.

Register no.	Name	
2	PT100_3	
	Unit	
	*C	
	Register	
	8022	
	Parameter a	Parameter b
	1	0

How does it work? - calibration



Calibration software created in Labview

The screenshot displays a LabVIEW calibration software interface. At the top, there are input fields for IP Address (192.168.1.1) and Port (502), along with a 'stop' button labeled 'STOP'. To the right, a 'Connection status' panel shows a green checkmark for 'status', an empty 'error code' field, and a 'source' dropdown menu.

Below these are three tabs: 'Overview', 'Calibrate', and 'Settings'. The 'Calibrate' tab is active, showing a 'Channel' dropdown set to '1', 'First temperature' set to '0' with a green indicator light, and 'Second temperature' set to '100' with a green indicator light. A status box contains the text: 'Status: waiting for second point', 'Now stabilize temperature at second point of reference', and a 'Next' button.

At the bottom of the 'Calibrate' tab, the calibration equation is shown: $t_{\text{calibrated}} = a * t_{\text{measured}} + b$, with input fields for 'a' (0) and 'b' (0).

On the right side, a 'Waveform Chart' displays a plot of 'Amplitude' versus 'Time'. The y-axis ranges from 19 to 28, and the x-axis ranges from 0 to 100. The plot shows a blue line that starts at an amplitude of approximately 27.8, remains constant until about time 10, then drops sharply to approximately 20 and remains constant thereafter. A 'Plot 0' button with a zoom icon is located above the chart.

Conclusion



Thank You



Slow Control System



DEFINITION:

The **Slow Control System (SCS)** is an electronic system, which is intended to support and enable operation of complex equipment for any physical experiment, e.g. for detectors in high energy physics experiments.



Slow Control System



CHARACTERISTICS of the SCS:

- Modular
- Scalable
- Multiuser
- Open
- EqDb (Database)



Slow Control System



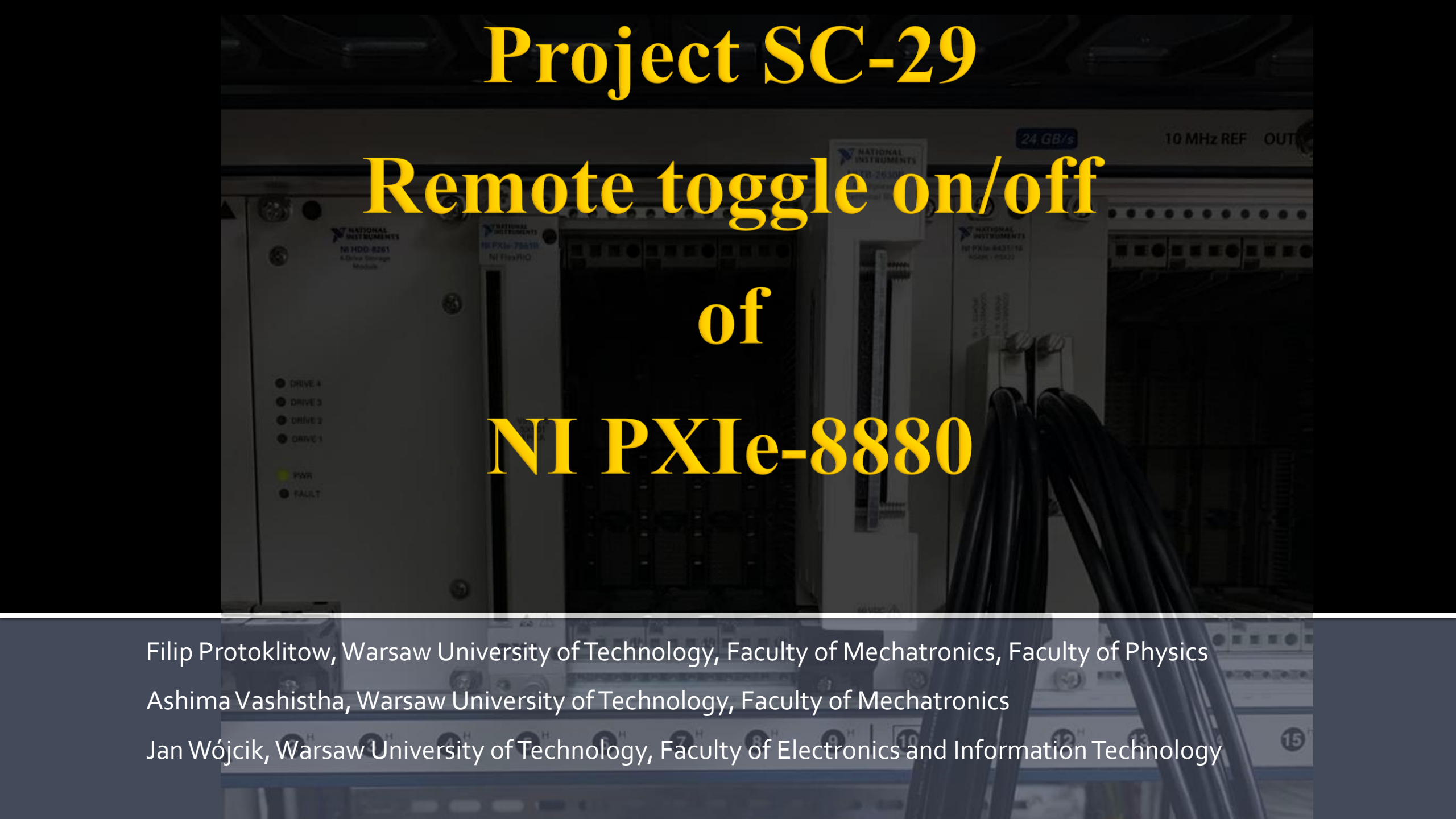
EXPECTED USE - support of the detectors in experiments at **JINR**
(**J**oint **I**nstitute for **N**uclear **R**esearch) in Dubna:

- **BM@N** (**B**aryonic **M**atter at **N**uclotron)
- **MPD – NICA** (**M**ulti-**P**urpose **D**etector)-
(**N**uclotron-based **I**on **C**ollider **f**Acility)

Importance of remote toggle

- Expensive restart
 - Vacuum
 - Superconductive environment
- Electric field
- Strong radiation





Project SC-29

Remote toggle on/off

of

NI PXIe-8880

Filip Protoklitow, Warsaw University of Technology, Faculty of Mechatronics, Faculty of Physics

Ashima Vashistha, Warsaw University of Technology, Faculty of Mechatronics

Jan Wójcik, Warsaw University of Technology, Faculty of Electronics and Information Technology

Requirements

- RJ-45
- LabVIEW

Features

- User prompt
- Remotely turning on/off
- Checking status
- Saving configuration in a file



PXIe - 8880

- **Intel Xeon 8-Core embedded controller**

- Eight-core, 2,3 GHz each, Intel® Xeon® E5-2618L v3 processor

- Up to 24 GB of DDR4 SDRAM

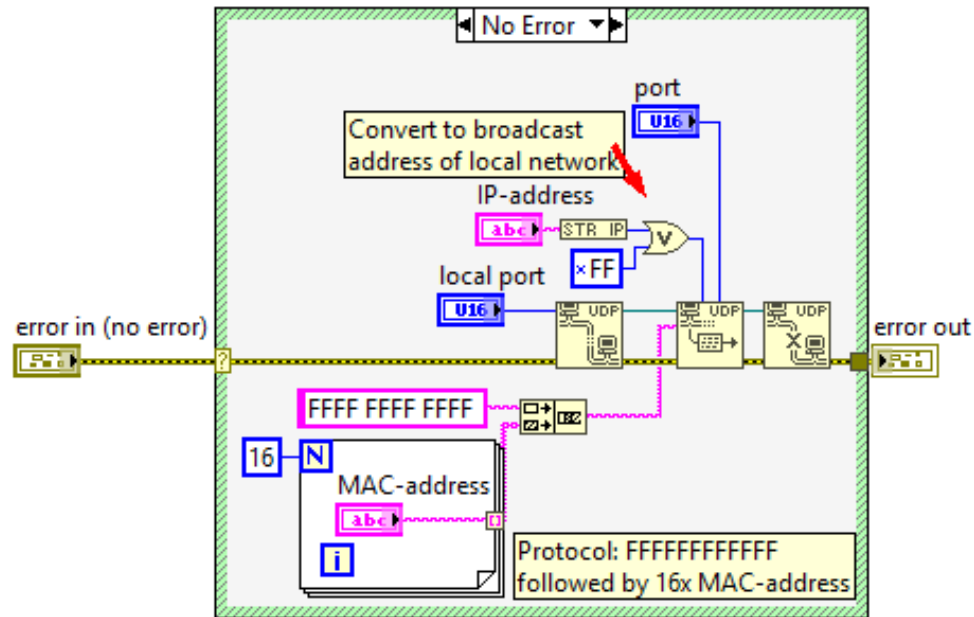
- AMD Radeon E6460 Embedded GPU

- Windows 7 installed



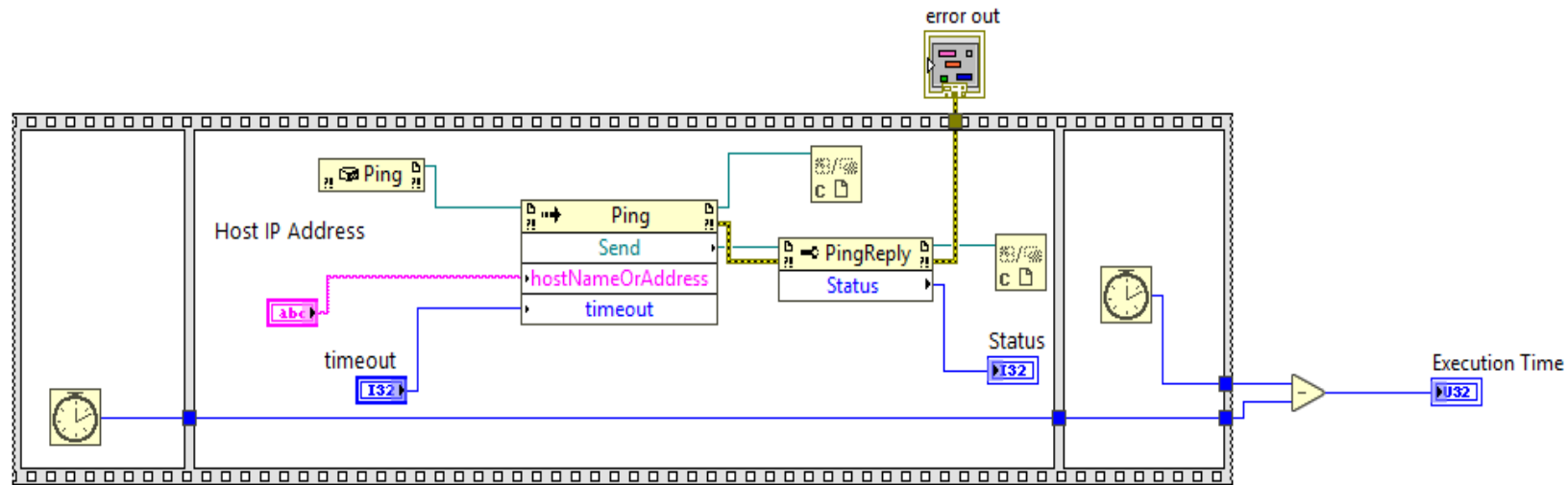
Turning on

- **Wake On Lan (WOL)**
 - **Magic packet** of 6 bytes of all 1's followed by 16 repetitions of the MAC address for the controller you want to wake.
 - IP address
 - MAC address
 - Port
 - Local port



Checking the status

- Pinging NI PXIe-8880 using remote computer via LabVIEW
 - IP address
 - Timeout (600 ms set as default)



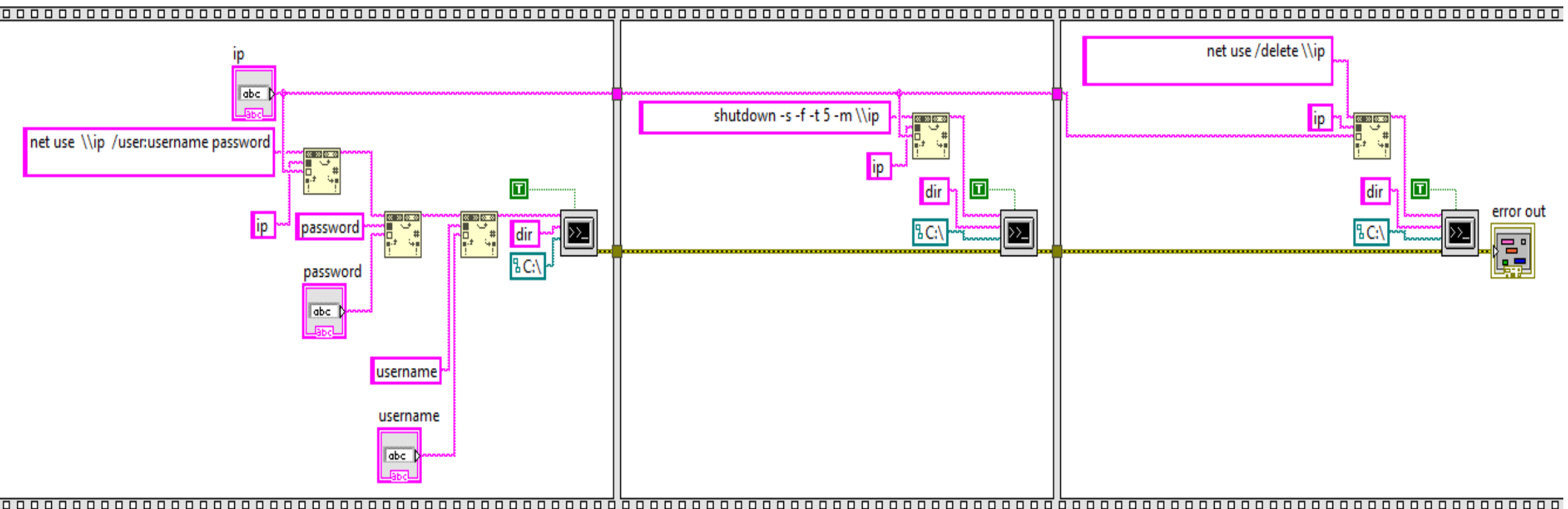
Saving the data

- The data is stored in an Xml file.
- Data Saved:
 - IP address
 - MAC address
 - Username
 - Password
 - Port
 - Local port

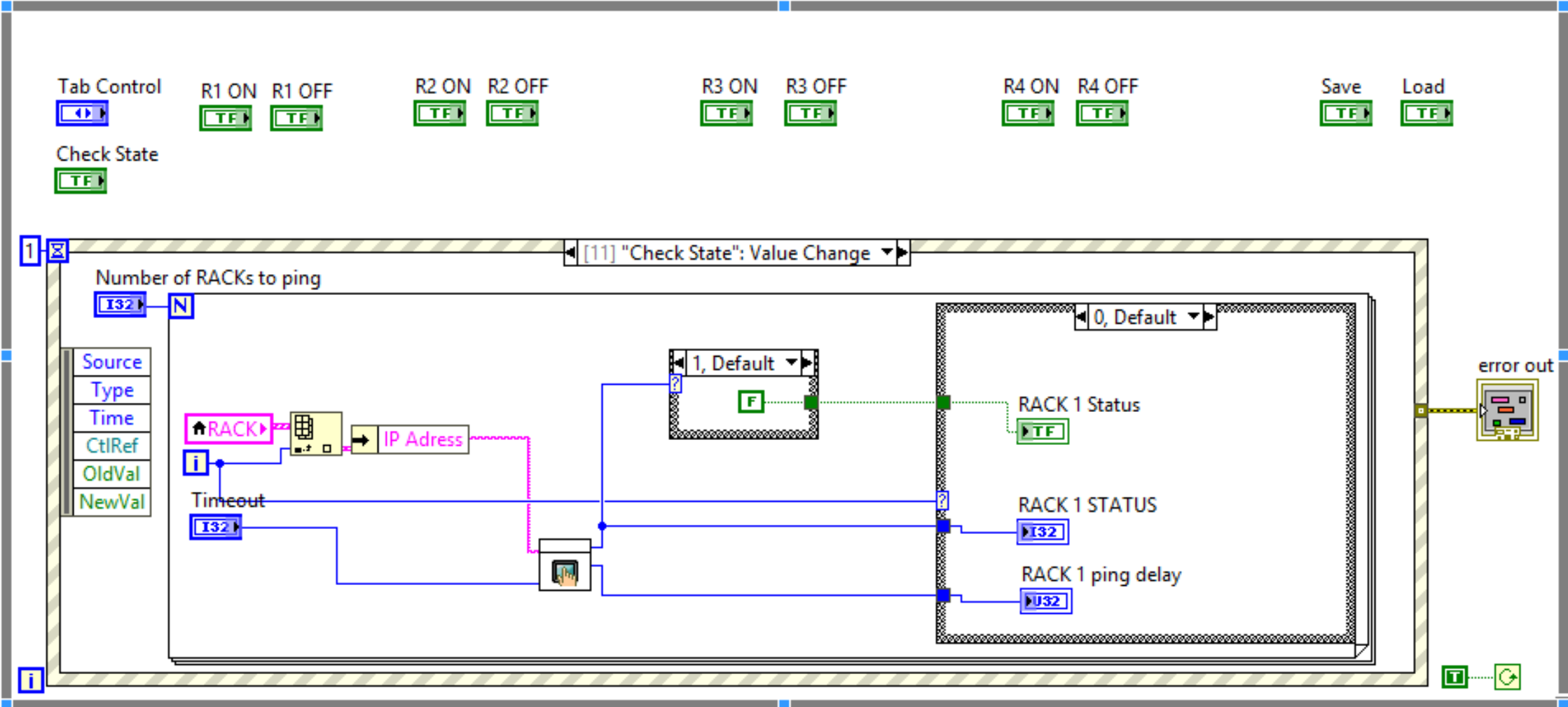
```
<?xml version='1.0' standalone='yes' ?>
<LVData xmlns="http://www.ni.com/LVData">
  <Version>17.0</Version>
  <Cluster>
    <Name>Data to save</Name>
    <NumElts>6</NumElts>
    <Array>
      <Name>RACK</Name>
      <Dimsize>1</Dimsize>
      <Cluster>
        <Name>Cluster</Name>
        <NumElts>6</NumElts>
        <String>
          <Name>IP Adress</Name>
          <Val>192.168.0.20</Val>
        </String>
        <String>
          <Name>MAC Adress</Name>
          <Val> €/% "</Val>
        </String>
        <I32>
          <Name>Port</Name>
          <Val>7</Val>
        </I32>
        <I32>
          <Name>Local Port</Name>
          <Val>0</Val>
        </I32>
        <String>
          <Name>Login</Name>
```

Shutting down

- Using LabVIEW to open cmd window on NI PXIe-8880 in order to automatically type shutdown command
- Required data: IP, username, password of the controller.



Final scheme



Run Panel

The screenshot displays the 'Run Panel' software interface. At the top, there are two tabs: 'Run Panel' (selected) and 'Engineering Panel'. Below the tabs, a section labeled 'ALL RACKS' contains two buttons: 'Turn On' and 'Turn Off'. The main area is divided into four sections, one for each rack (RACK 1 to RACK 4). Each rack section includes a 'Turn On' button, a 'Turn Off' button, a status indicator (a green bar followed by the text 'RACK X Status'), a status text box (all showing 'Unknown'), and a 'ping delay' text box (all showing '0'). At the bottom left, there is a 'Check State' button, and at the bottom right, there is an 'About' button.

Rack	Turn On	Turn Off	Status	Ping Delay
RACK 1	Turn On	Turn Off	Unknown	0
RACK 2	Turn On	Turn Off	Unknown	0
RACK 3	Turn On	Turn Off	Unknown	0
RACK 4	Turn On	Turn Off	Unknown	0

Engineering Panel

Run Panel Engineering Panel

Data to save

RACK

0

IP Address: 192.168.0.20 Port: 7

MAC Address: 0080 2F25 8894 Local Port: 0

Login: Krystian Password: ****

Enable auto ping: Number of RACKs to ping: 1 Timeout: 400

Auto ping delay(s): 30 Powering up all RACKs delay(s): 0

Config File Path: C:\PXIe\PXIEthernetValues.xml

Error

status: code: 0

source:

Save OK Load OK

Summary

- Made for 4 racks but can be **modified** to add more
- 2 pannels that can be adjusted according to the users' demand
- Simultaneously checking status of each rack
- Turning on/off all racks at once

Thank You

In case of fire

- No human access
- Extinguish certain rack on fire





**GDAŃSK UNIVERSITY
OF TECHNOLOGY**



Fire extinguishing system


Authors:

Agnieszka Domalewska, Gdańsk University of Technology

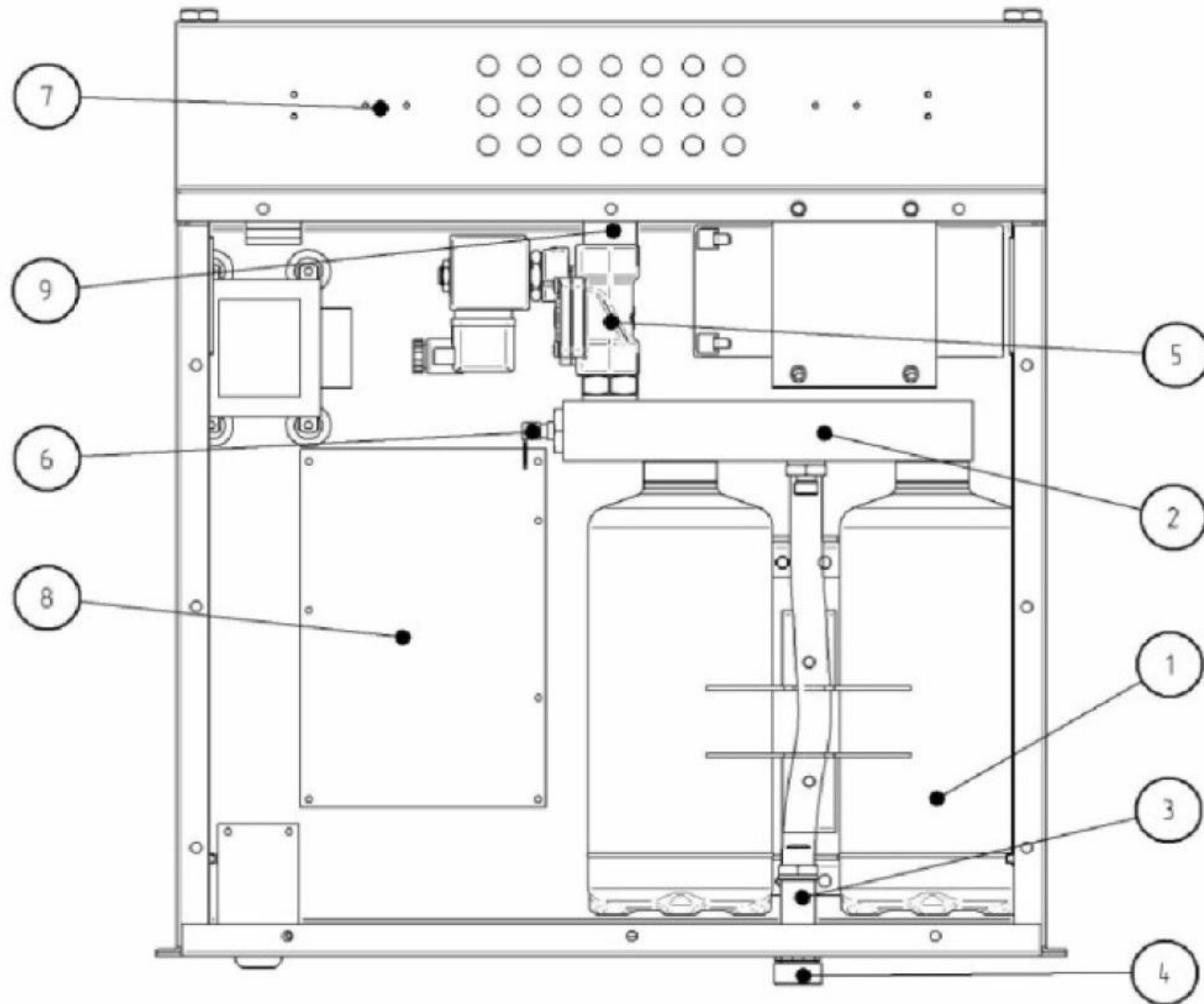
Szymon Rowiński, Warsaw University of Technology

Radosław Krzosa, Warsaw University of Technology

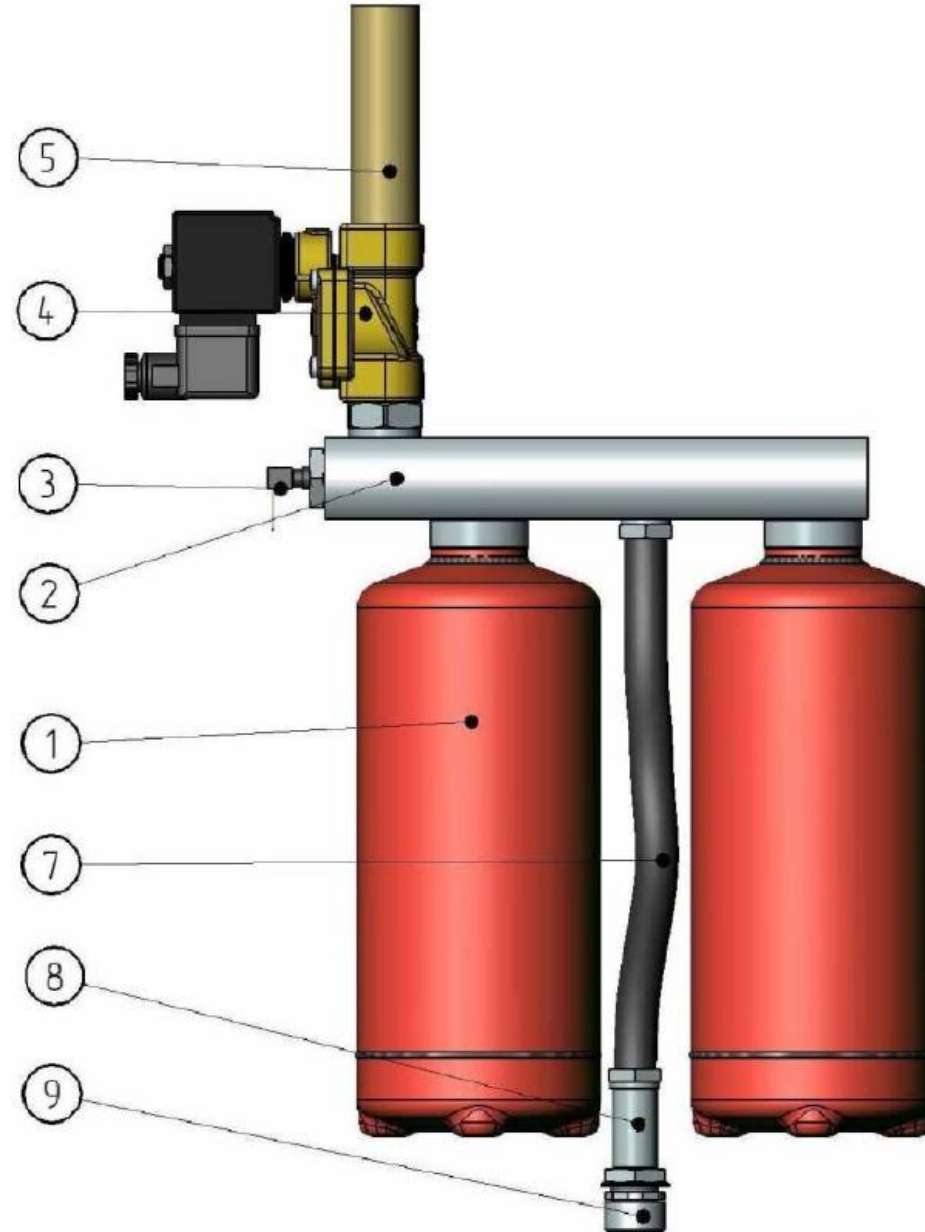
PROJECT PURPOSE

- ▶ Connecting to the FRS–RACK Master and Slave extinguishing modules
 - ▶ Communication and checking the working parameters
 - ▶ Creating the LabView software
- 

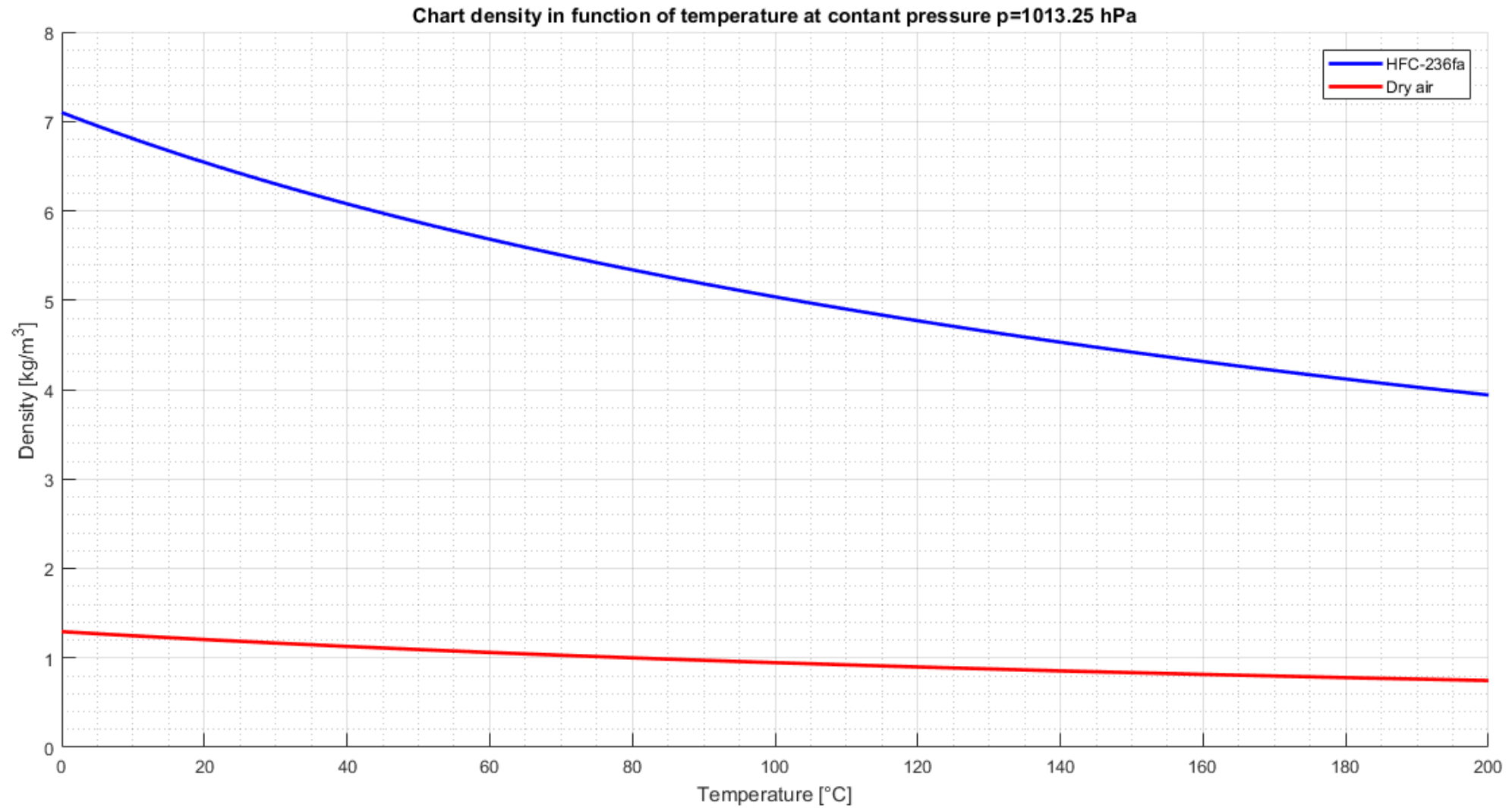
FRS-RACK



EXTINGUISHING UNIT

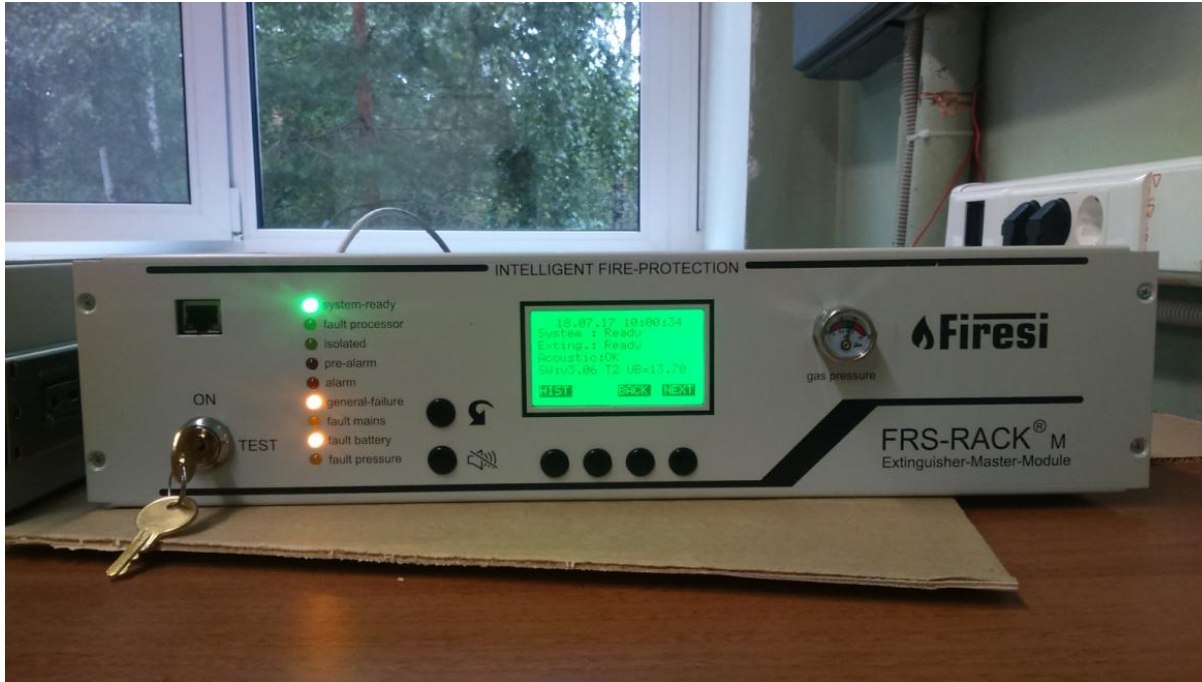


EXTINGUISHING AGENT

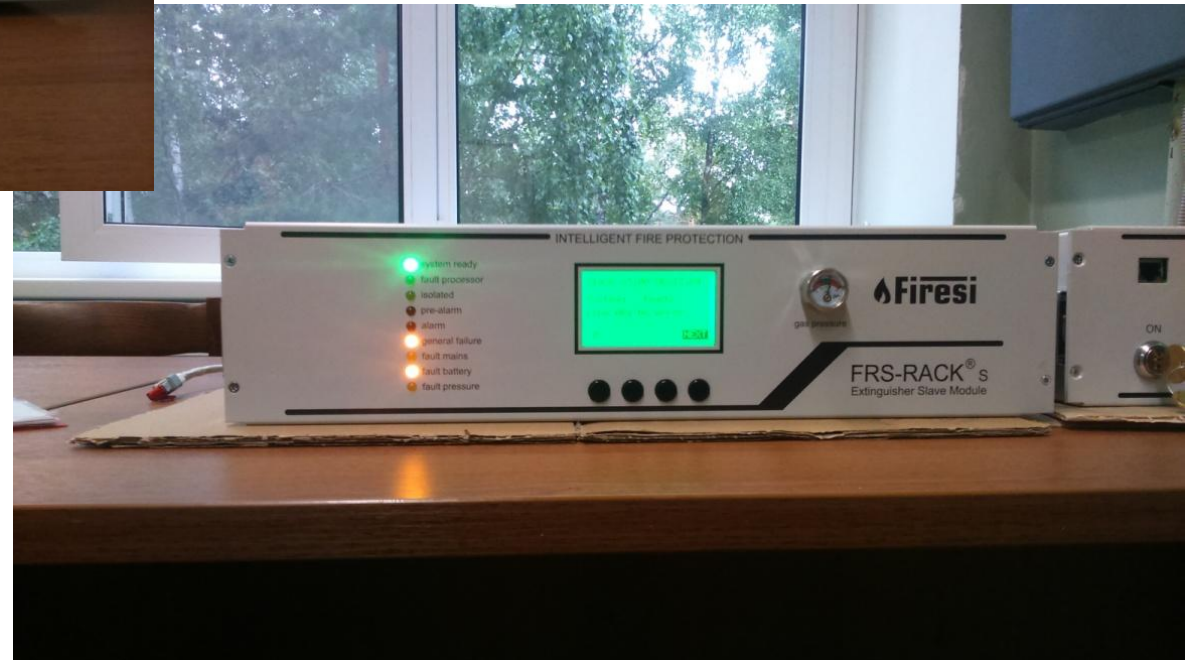


FRS-RACK DEVICE

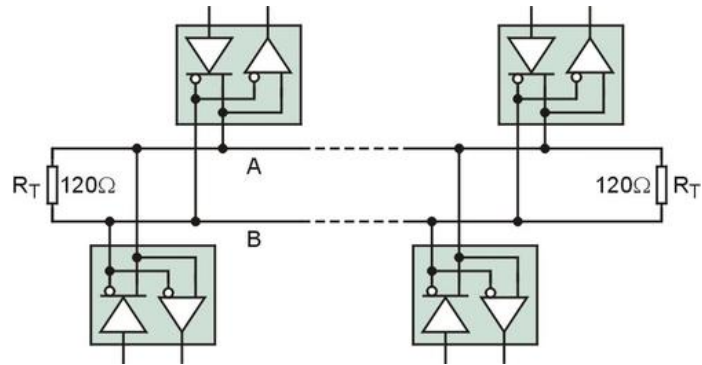
Master module



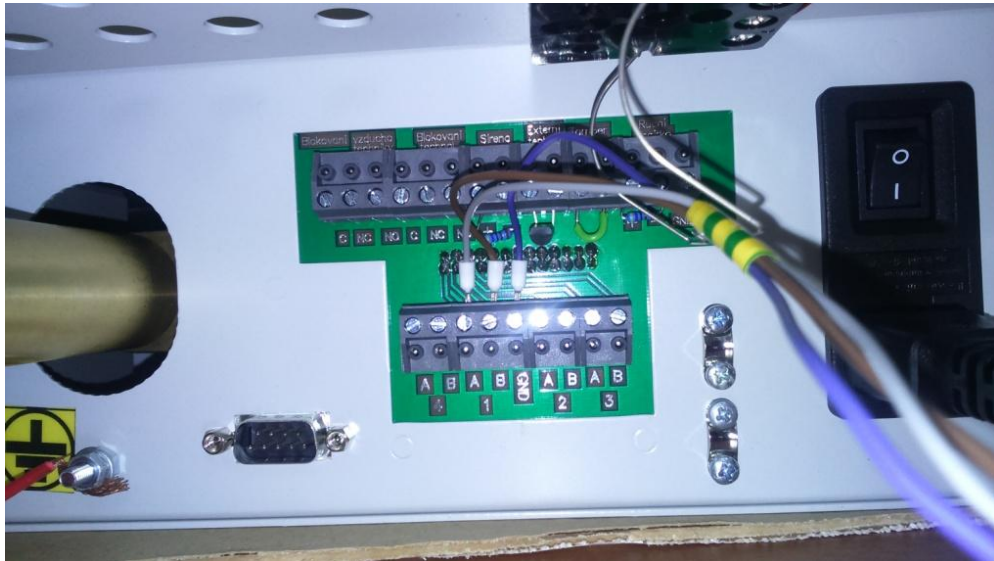
Slave module



MASTER – SLAVE COMMUNICATION



RS485 serial connection



Master connection



Slave connection

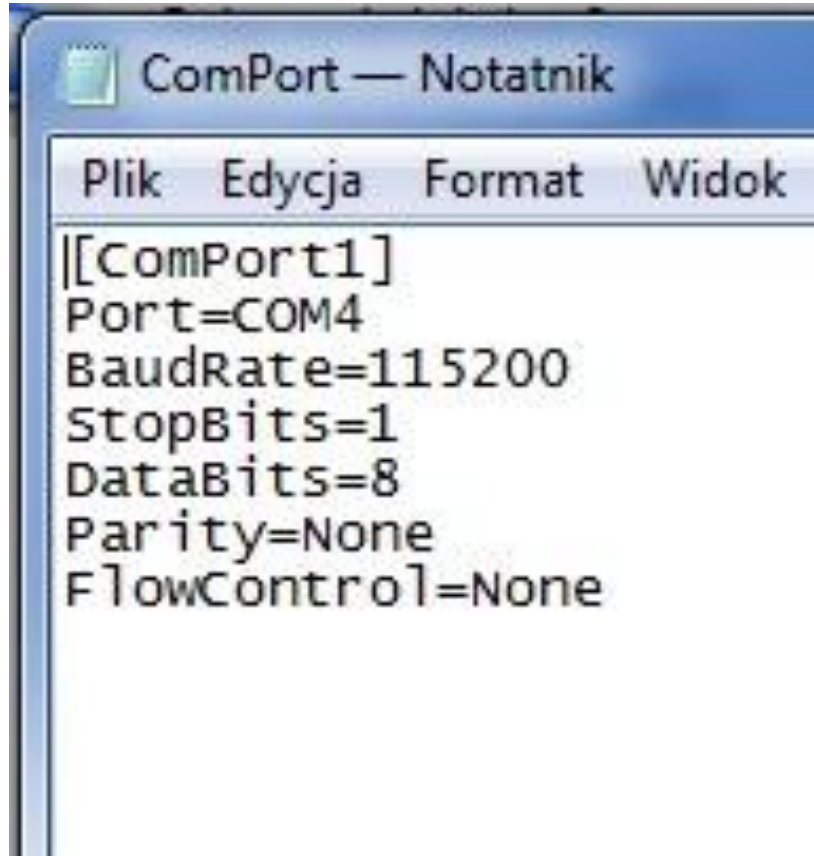
COMMUNICATION WITH A MODULE



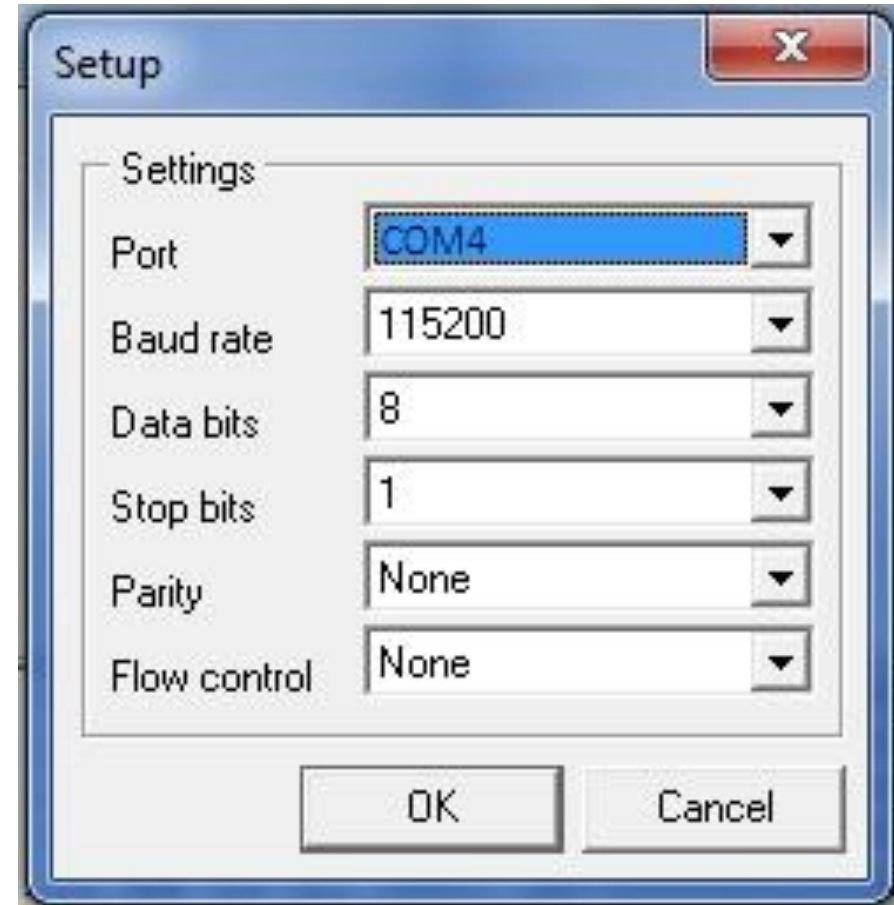
RS232 and Ethernet ports



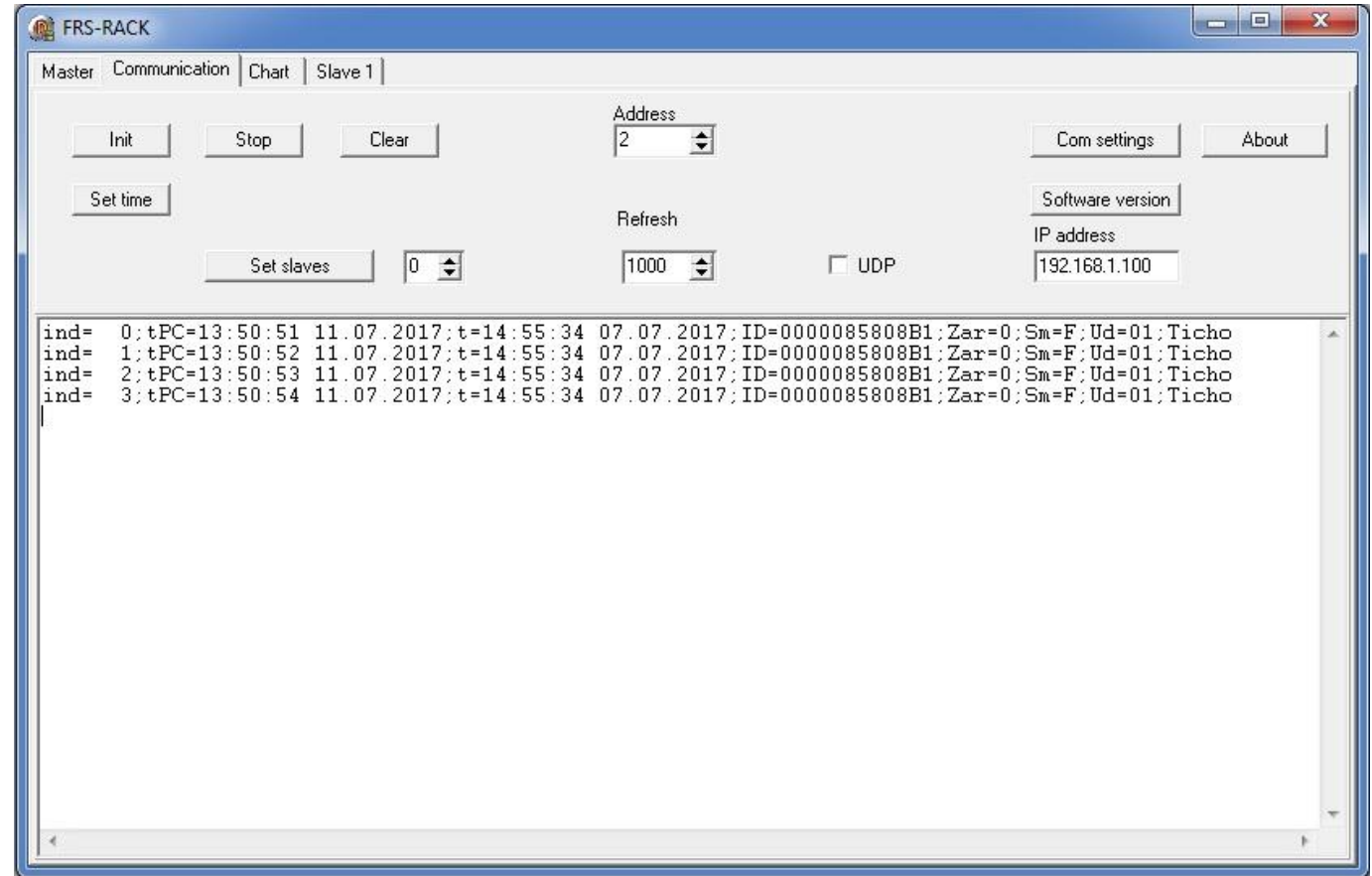
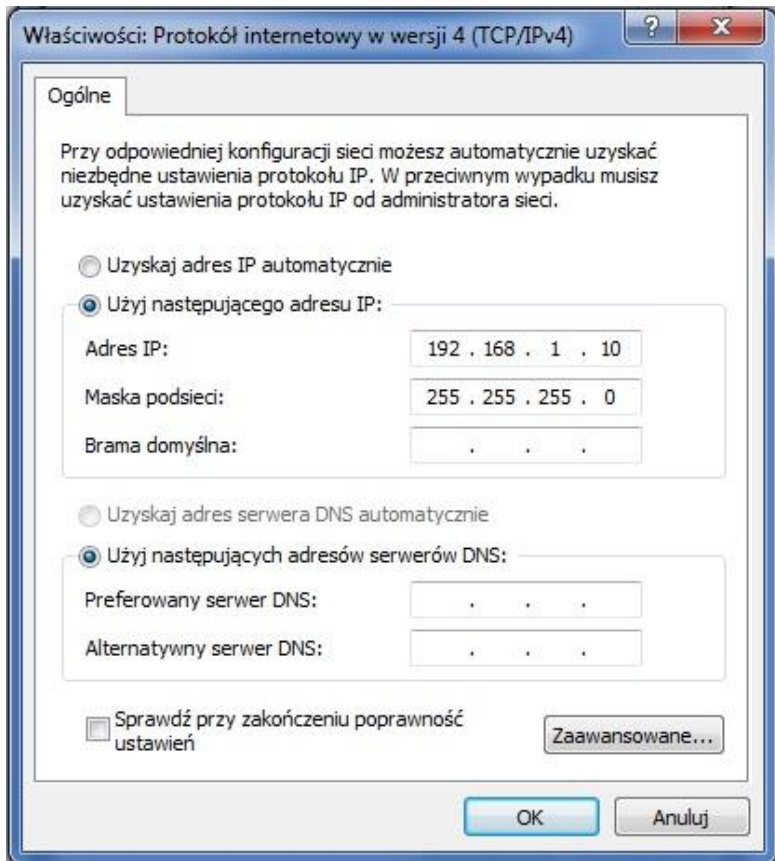
SET UP A CONNECTION THROUGH RS232 PORT



```
[[ComPort1]
Port=COM4
BaudRate=115200
StopBits=1
DataBits=8
Parity=None
FlowControl=None
```



SET UP AN ETHERNET CONNECTION



MAIN PARAMETERS

FRS-RACK

Master | Communication | Chart | Slave 1

System state

- Ready
- Prealarm A
- Reset A
- Prealarm B
- Reset B
- Delayed Ex.
- Exting. Time
- Extinguished
- Reset A+B
- Reset

Line A [0]

- Silent
- Test disc.
- Disconn.
- Test short
- Short
- Test Al.
- Alarm
- Test fail.
- Failure
- Off

Line B [1]

- Silent
- Test disc.
- Disconn.
- Test short
- Short
- Test Al.
- Alarm
- Test fail.
- Failure
- Off

Buttons [2]

- Silent
- Test disc.
- Disconn.
- Test short
- Short
- Test Al.
- Alarm
- Test fail.
- Failure
- Off

Int. temp: 25,2 C
Ext. temp: 27,7 C
Batt. temp: 25,4 C
Pressure: 16,42 Bar

Relay state

- Coiling
- Technologic
- Alarm
- Pre alarm
- Failure
- Test
- Acoustic
- Valvel 1
- Valvel 2

Valve 1 state

- OK
- Raised resistance
- Disconnected
- Short

Acoustic state

- OK
- Disconnected
- Short

Battery state

- OK
- Failure
- Charging
- Discharged

Operation state

- Ready
- Preparation
- Test
- Stop

Time: 0,0 s

Lines voltage

A	B	C	Lines voltage
22,142 V	22,392 V	22,136 V	22,57 V

Battery 13,70 V **Mains** 22,40 V **Acoustic** 10,644

ID 0000085808B1 **Valve 1** 00,851









Legend:

- Sys. ready
- Test
- Stop extinguis.
- Prealarm A+B
- Alarm
- Failure
- Memory fault
- Fault processor
- Fault loop A+B
- Fault loop C
- Fault pressure
- Fault mains
- Fault battery
- Fault acoustic
- Fault valve
- Fault slave1
- Fault slave2
- Fault slave2
- Fault slave4
- Fault slave4
- Fault comm.
- Door contact

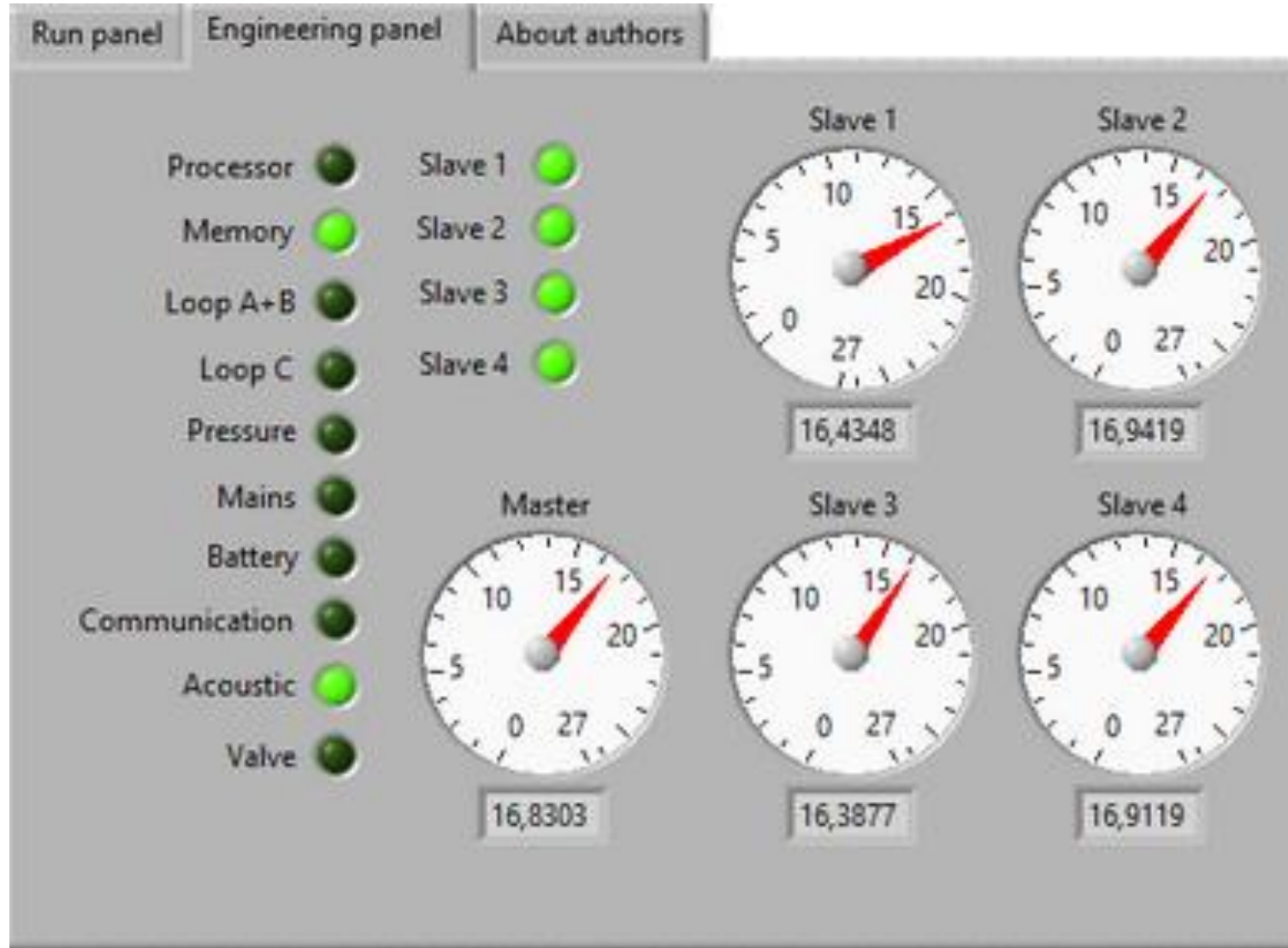
Start: 488 End: 487 Max: 1000

LABVIEW SOFTWARE

Run panel Engineering panel About authors

Temperature	Voltage	Lines Current	Lines Voltage	
External 25,6	Battery 13,65	A 4,85	A 22,402	Test mode 
Internal 25,9	Mains 22,33	B 4,95	B 22,148	Normal mode 
Battery 25	Acoustic 0	C 4,86	C 22,502	System ready 
			Summary 67,562	General failure 
Pressure				Stop extinguish 
	Master 0			Prealarm A+B 
				Alarm 
				Door contact 
Slave 1 0	Slave 2 0	Slave 3 0	Slave 4 0	
			IP adres 0	
			Master ID 904	
				Valve 1 0,849

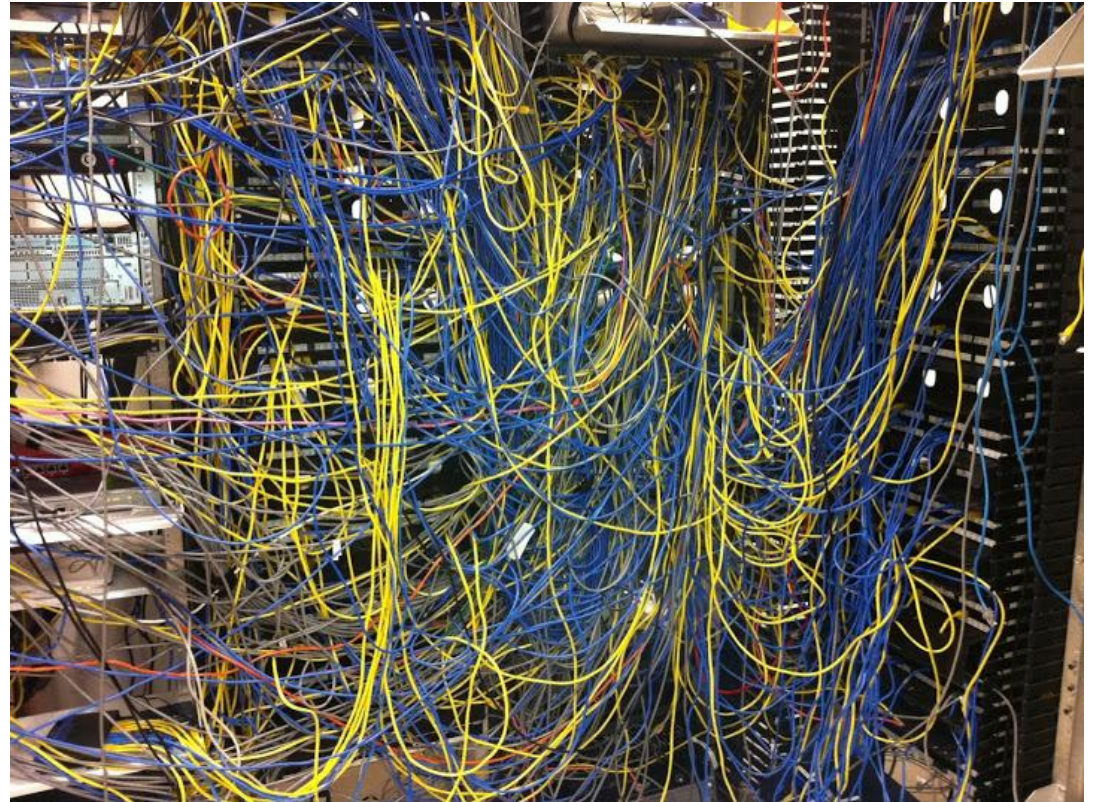
LABVIEW SOFTWARE



Thank you for attention!

Importance of intelligent power distribution

- Symmetrize power supply
- Swaping phases
- Symmetrize system
- No human access



Electrical network analyzer

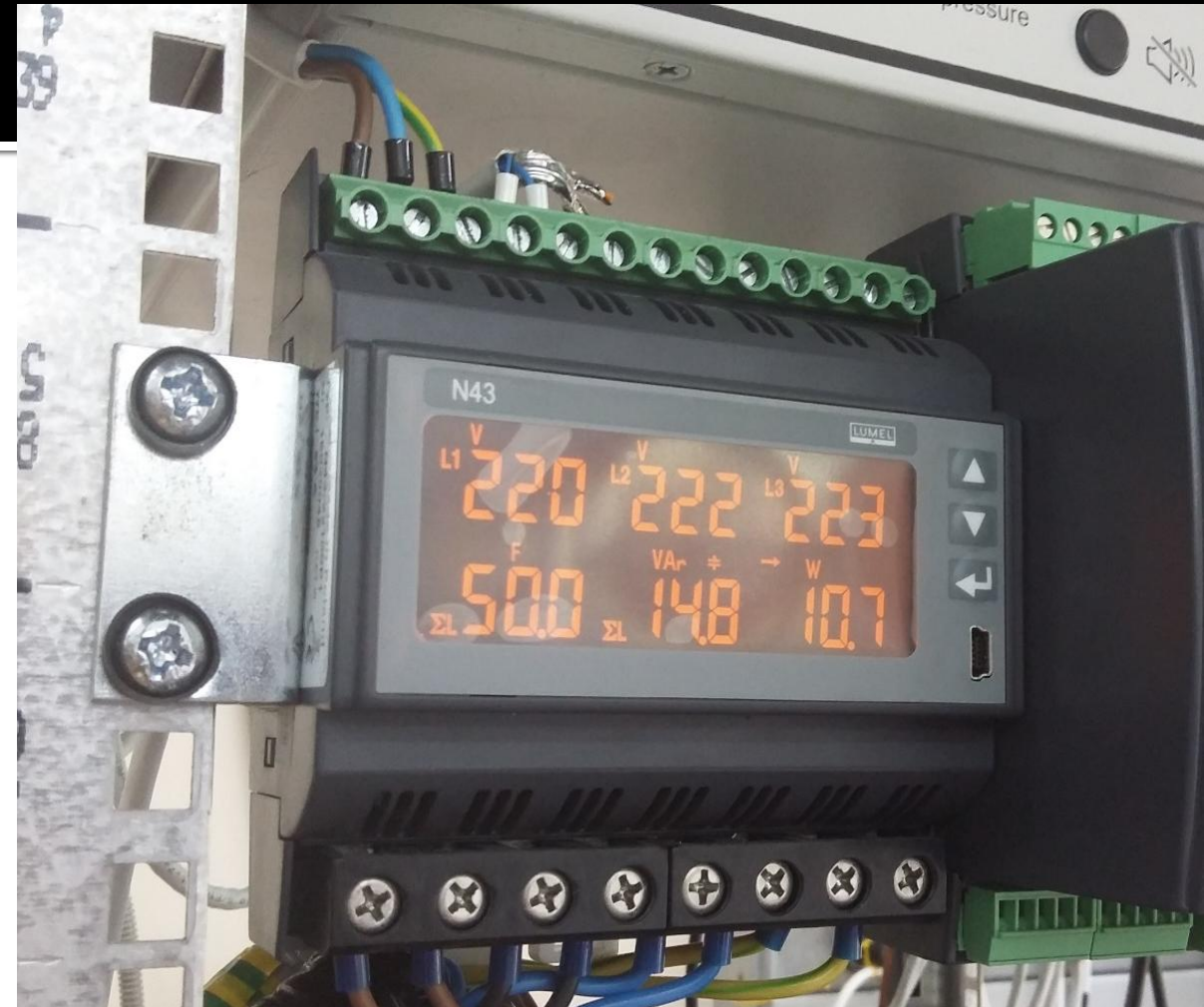
Barbara Kędzierska, Warsaw University of Technology, Faculty of Power and Aeronautical Engineering
Tomasz Kowalski, Warsaw University of Technology, Faculty of Electronics and Information Technologies
Supervisor: Marek Peryt

Goal of the project

- Smart energy distribution and power network analysis

Our tasks

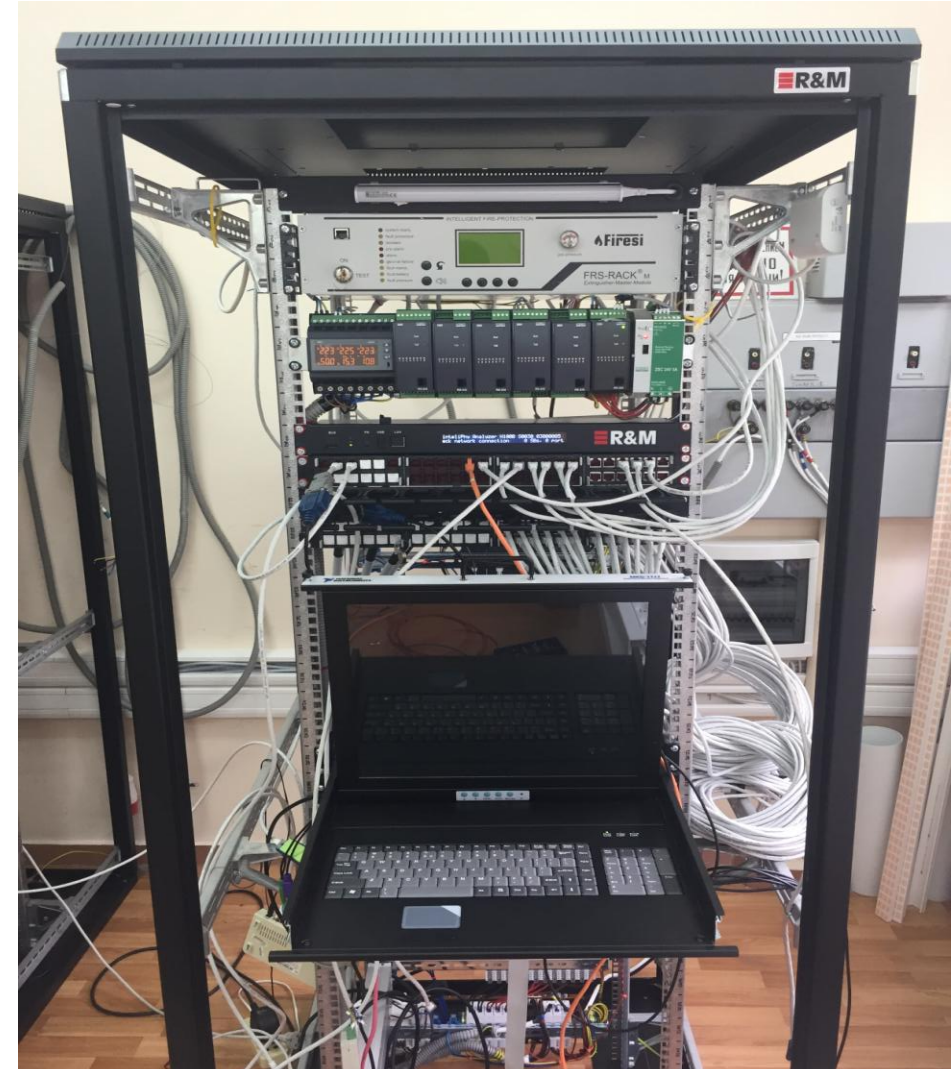
- Communication with the electrical network analyzer by PXIe serial modul
- Measuring and displaying network parameters on the self-made interface
- Sending data to another program which controls switching on devices to power network



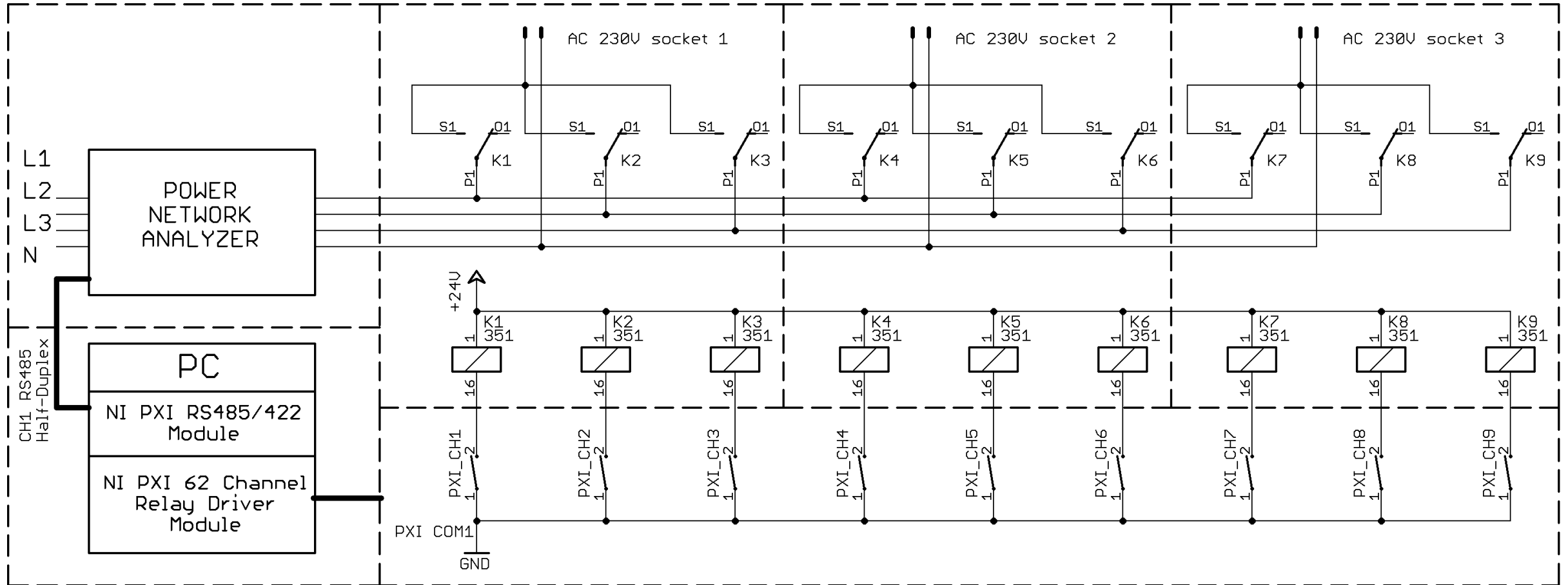
Why electrical network analysis is important?

Network analysis:

- General information about conditions of power network and total power consumption by our system
- Measurement of devices power consumption gave us information about:
- Device is connected properly to a power network
- Connect different devices to different phases in order to achieve equal load of electrical network



System architecture



Lab stand



User interface

- Allows to display 7 parameters for each phase
- Red indicator appears if phase is loaded
- Display can be stopped by pressing the yellow button

VISA resource name
COM32

FREQUENCY [Hz] CURRENT IN {N} VECTOR

50,0212 0

PHASE L1 **PHASE L2** **PHASE L3**

Phase	Voltage [V]	Current [A]	Real Power [W]	Reactive Power [VAr]	Apparent Power [VA]	Active Power Coefficient	Phase Tangent {Q1/P1}
L1	219,928	0,0415	0	-9,126	9,1261	1000000000000000000000	1000000000000000000000
L2	221,933	0	0	0	0	1000000000000000000000	1000000000000000000000
L3	220,852	0	0	0	0	1000000000000000000000	1000000000000000000000

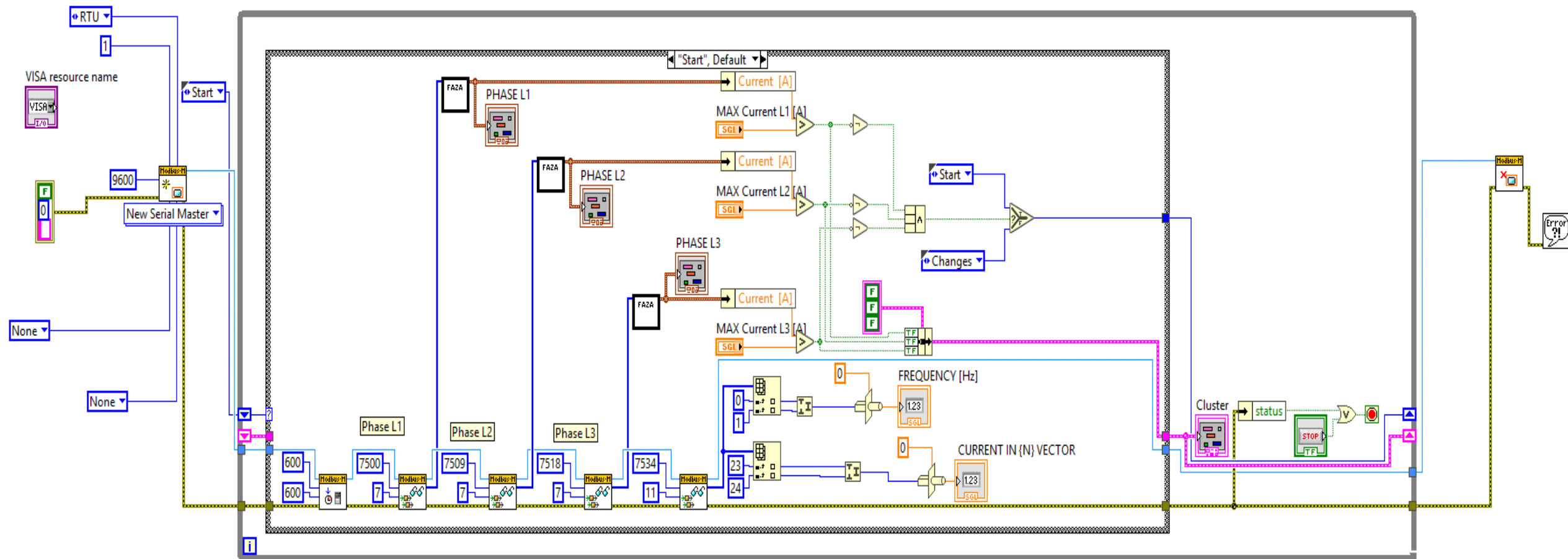
MAX Current L1 [A] **MAX Current L2 [A]** **MAX Current L3 [A]**

0 0 0

Red indicator button (L1) Green indicator button (L2) Green indicator button (L3)

Yellow bar on the right side of the interface.

What is behind?



Part of common project

The image shows a LabVIEW interface for 'TestPowerSequence2.vi' and a Windows file explorer window. The LabVIEW interface includes a menu bar (File, Edit, View, Project, Operate, Tools, Window, Help), a toolbar with run and stop buttons, and a main panel with the following elements:

- Virtual Device Name (SwitchConfiguration1):** A dropdown menu showing 'PXIController' and 'VISA Refnum in' set to 'COM32'.
- Time to wait - relay turned on[s]:** A numeric control set to '3'.
- Actual route connected:** A dropdown menu showing 'A8->B'.
- Scanning:** A green indicator light.
- Current Device Power:** A numeric control showing '0,461'.
- Table:** A table with two columns: 'Device ID' and 'Power consumption [W]'.

Device ID	Power consumption [W]
1	38,203
2	41,966
3	41,916
4	57,416
5	61,049
6	61,079
7	0,461
0	0
0	0
- Text:** 'Time between switching relays - 5 s' and 'Device ID corresponds to the used port by the relay'.

The Windows file explorer window shows the 'PowerDistributor' folder with the following contents:

Name	Date modified	Type
PD_alfa	13.07.2017 9:32	File folder
Pd_beta	17.07.2017 12:36	File folder
Control 1	12.07.2017 13:38	LabVIEW Control
Faza	17.07.2017 10:13	LabVIEW Instrume...
PowerDistributor2	17.07.2017 14:21	LabVIEW Instrume...
SingleProbeSubVi	17.07.2017 14:24	LabVIEW Instrume...
SingleProbeNetworkAnalyzer	17.07.2017 14:24	LabVIEW Instrume...
TestDoubleConnection	17.07.2017 17:11	LabVIEW Instrume...
TestPowerSequence2	18.07.2017 11:56	LabVIEW Instrume...

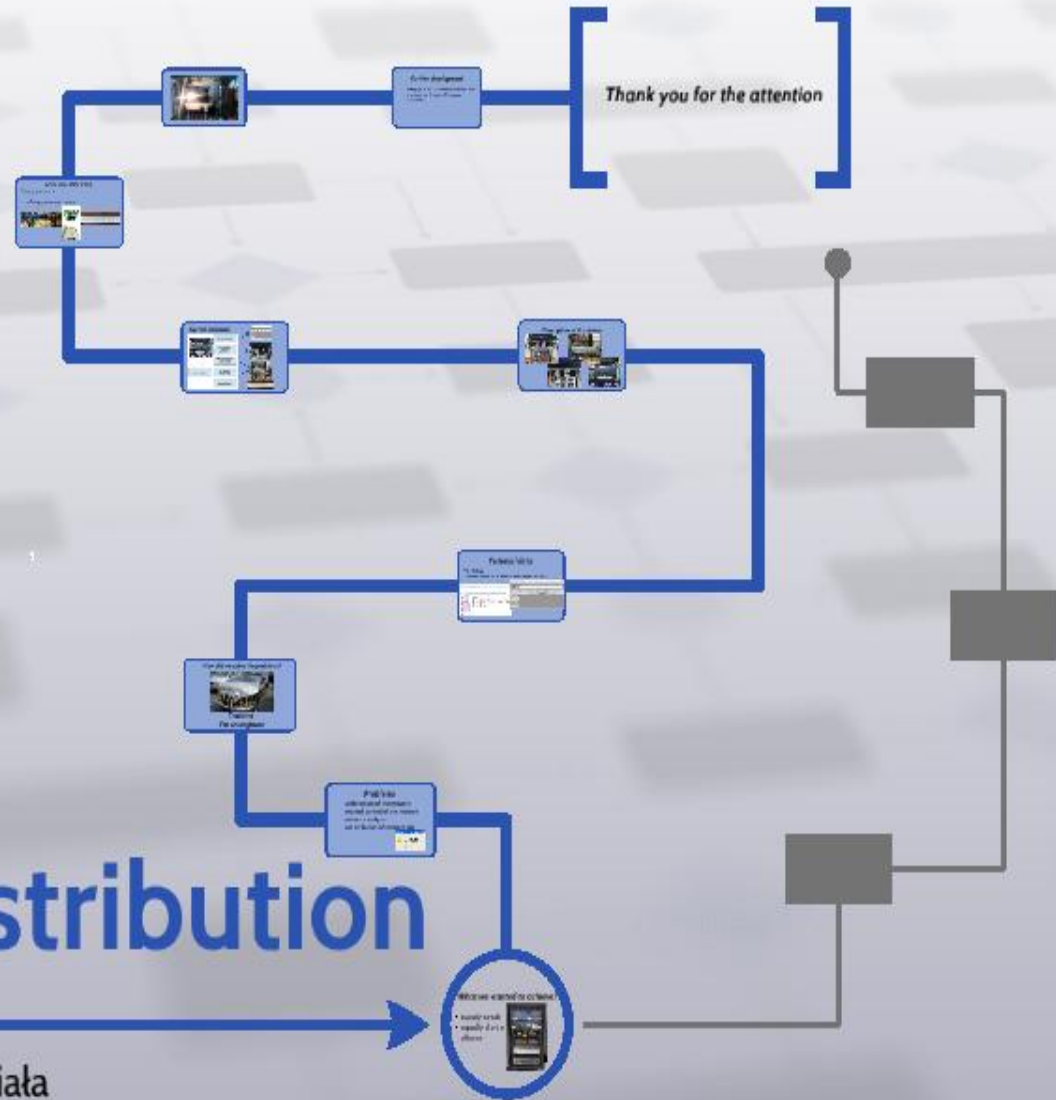
The taskbar at the bottom shows the system clock as 13:06 on 18.07.2017.

Thank you!

Intelligent Power Distribution

Aleksandra Fliszkiewicz, Tomasz Zalewski, Klaudia Zardzewiała

Dubna, 20.07.2017





What we wanted to achieve?

- supply a rack
- equally divide phases



Problems

- architecture of the network
- manual control of the network
- network analysis
- redistribution of connections



How did we solve the problems?

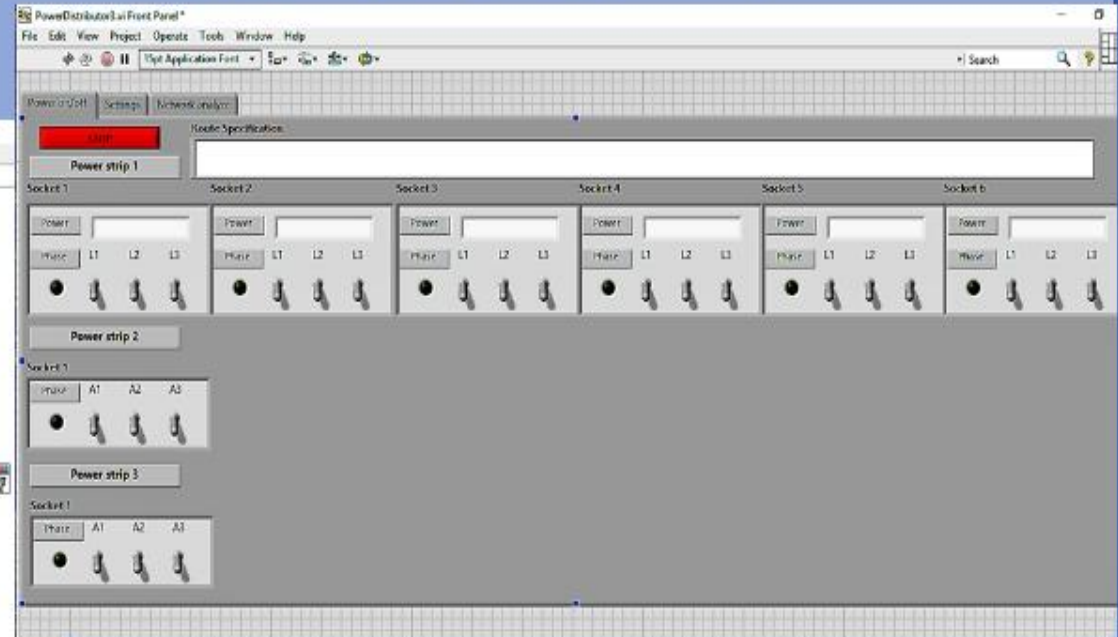
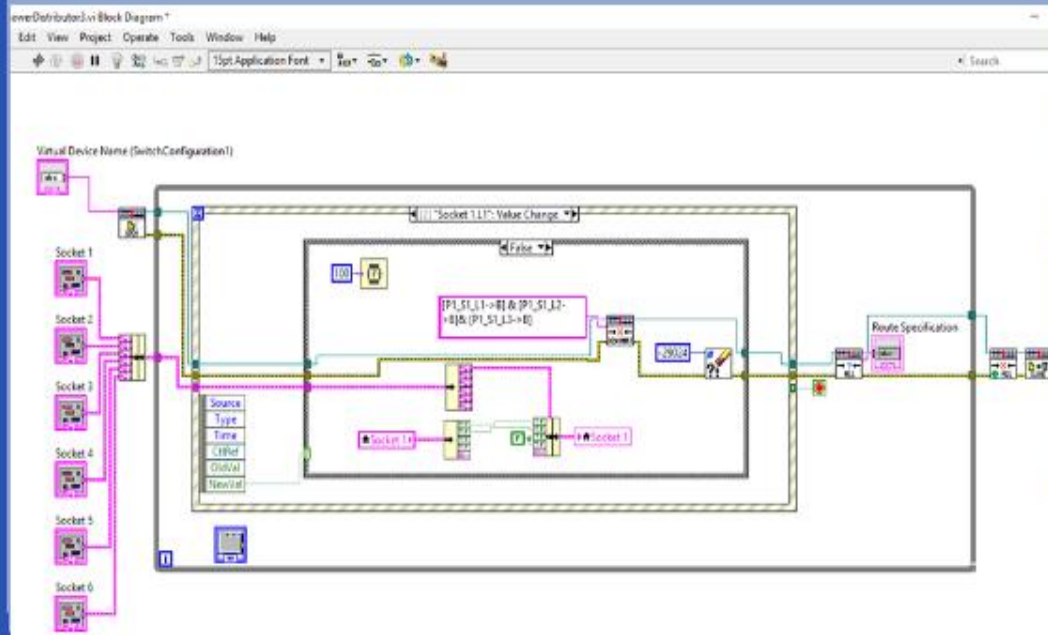


**Trust me,
I'm an engineer**

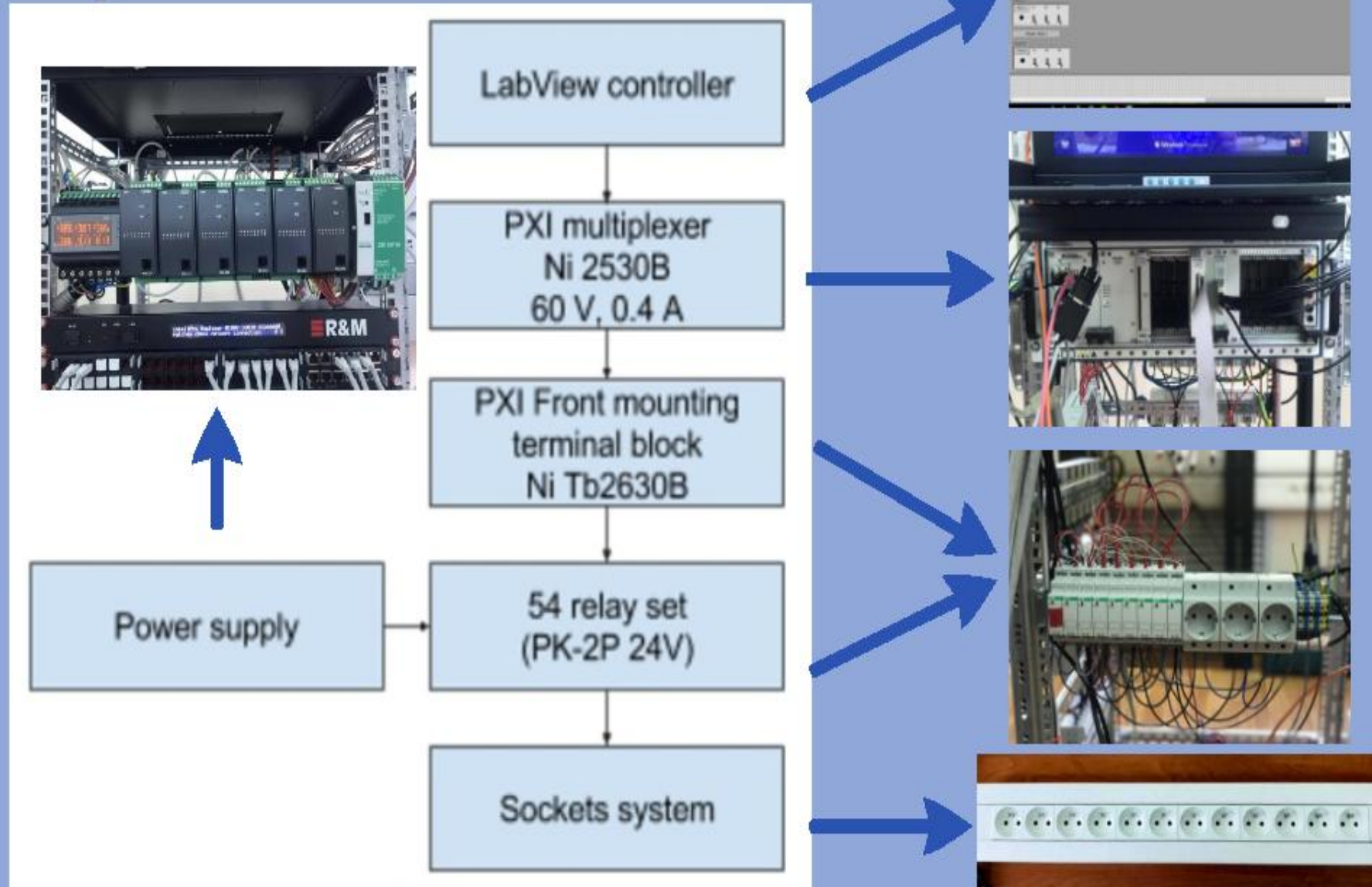
Technical data

Used programs:

- LabVIEW 2016
- NI Switch Executive (and NI-Switch 15.0 driver) configured with NI MAX



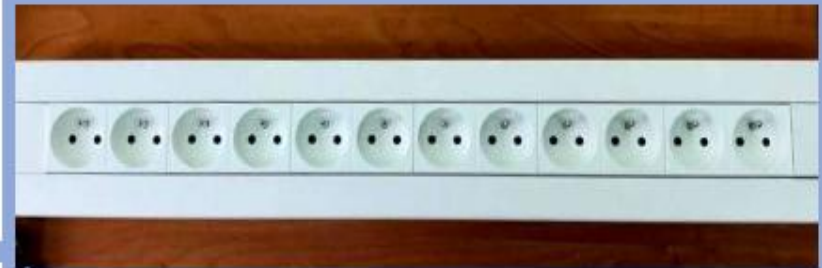
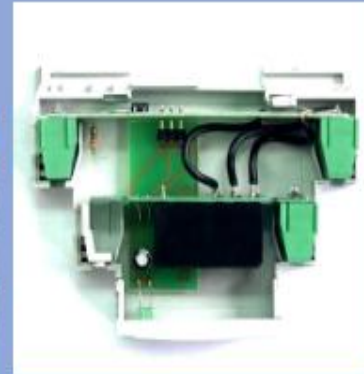
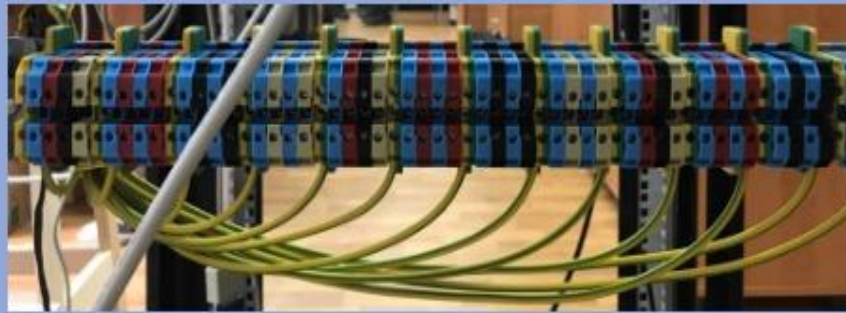
System structure

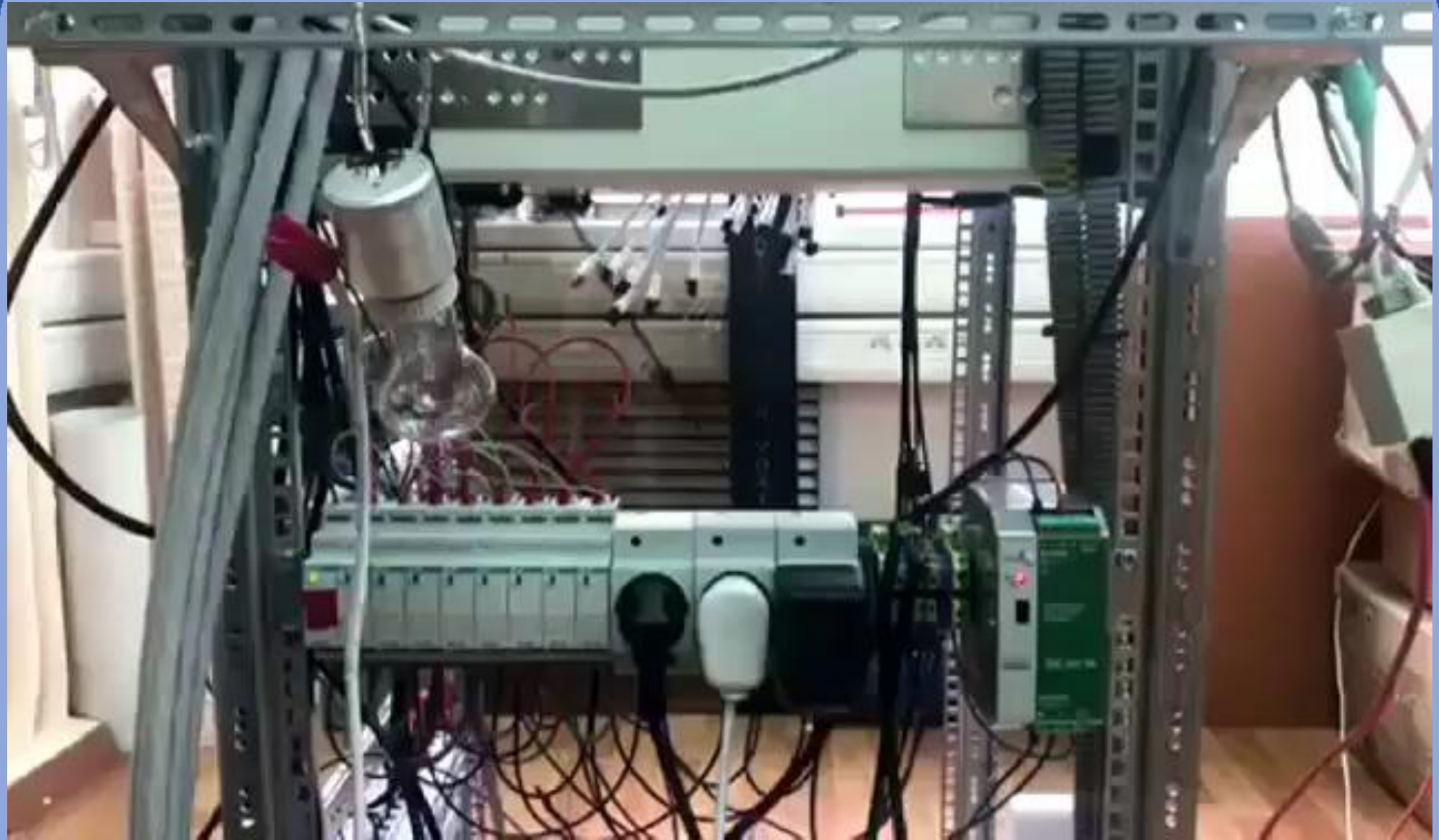


Current status of the project

The device is connected to:

- din rail
- relays
- power strips (there will be 3 in each rack).





Further development

- finding optimized solution for the network load
- automated redistribution of the relays connections



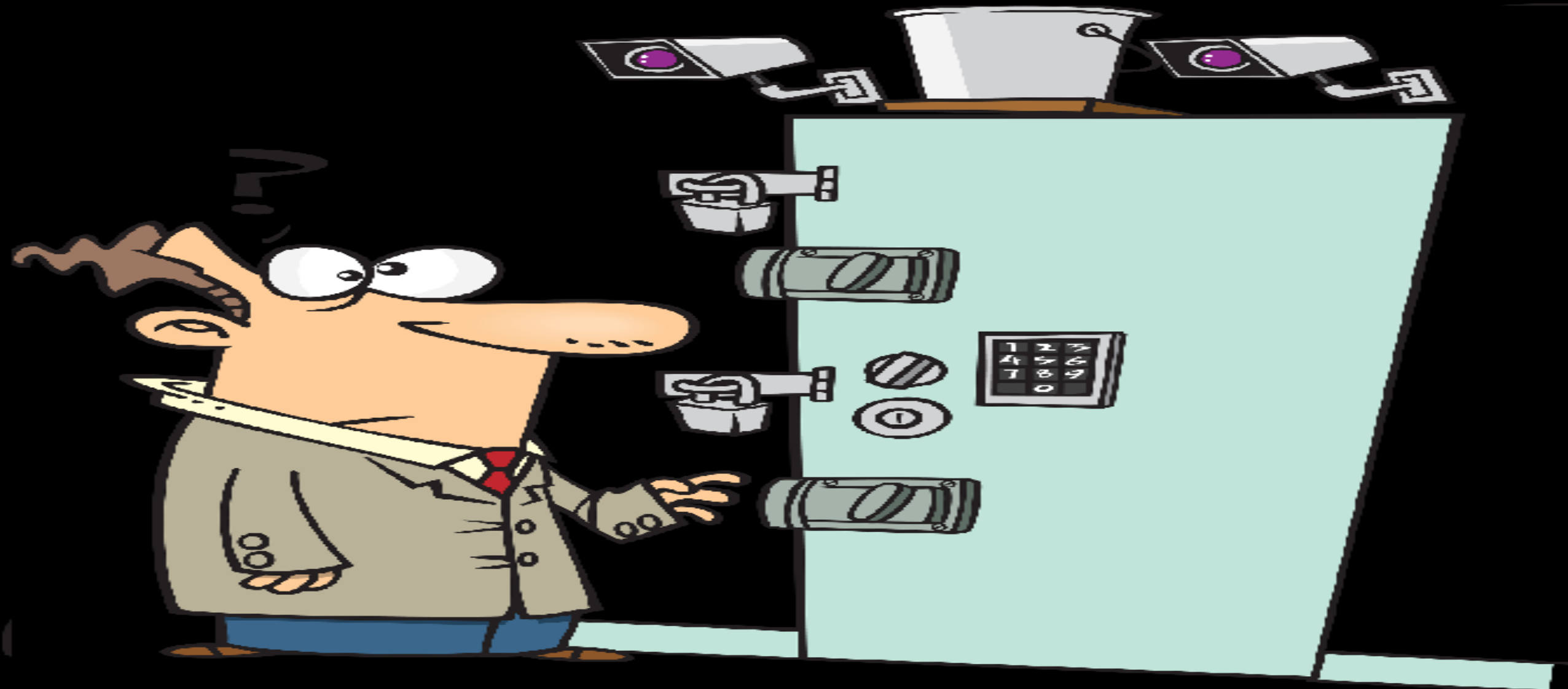
Thank you for the attention

Restricted access

Preventing unauthorized access



Electronic Lock



Plan of presentation

- The goal of our project
- Elements used
- The course of action
- Final result
- What's next?

Our objective

- To lock a door



Elements used

- Network Controller
- Communication Interface



Elements used

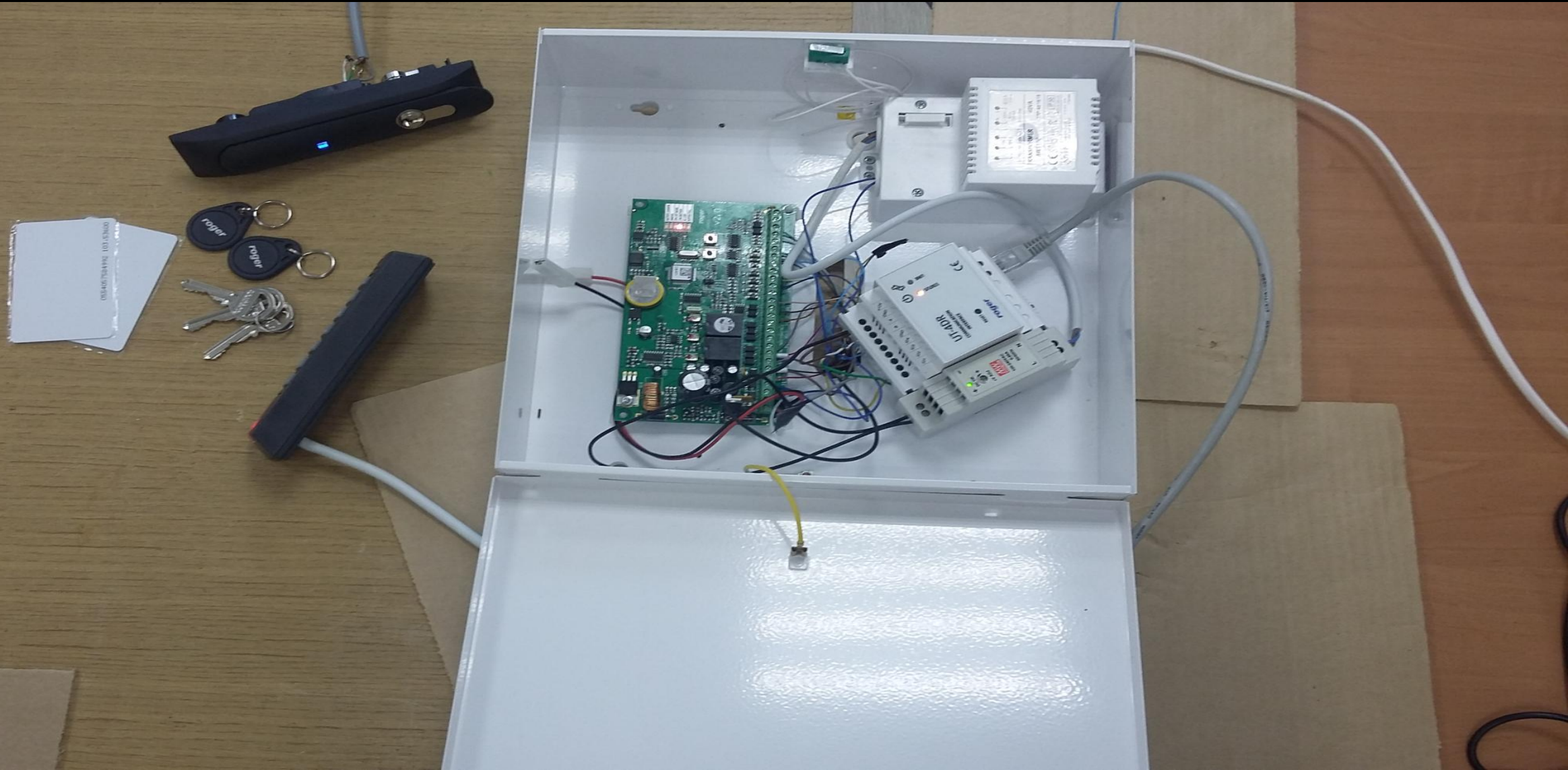
- Access Controller
- Metal Enclosure with Transformer
- Electronic Lock



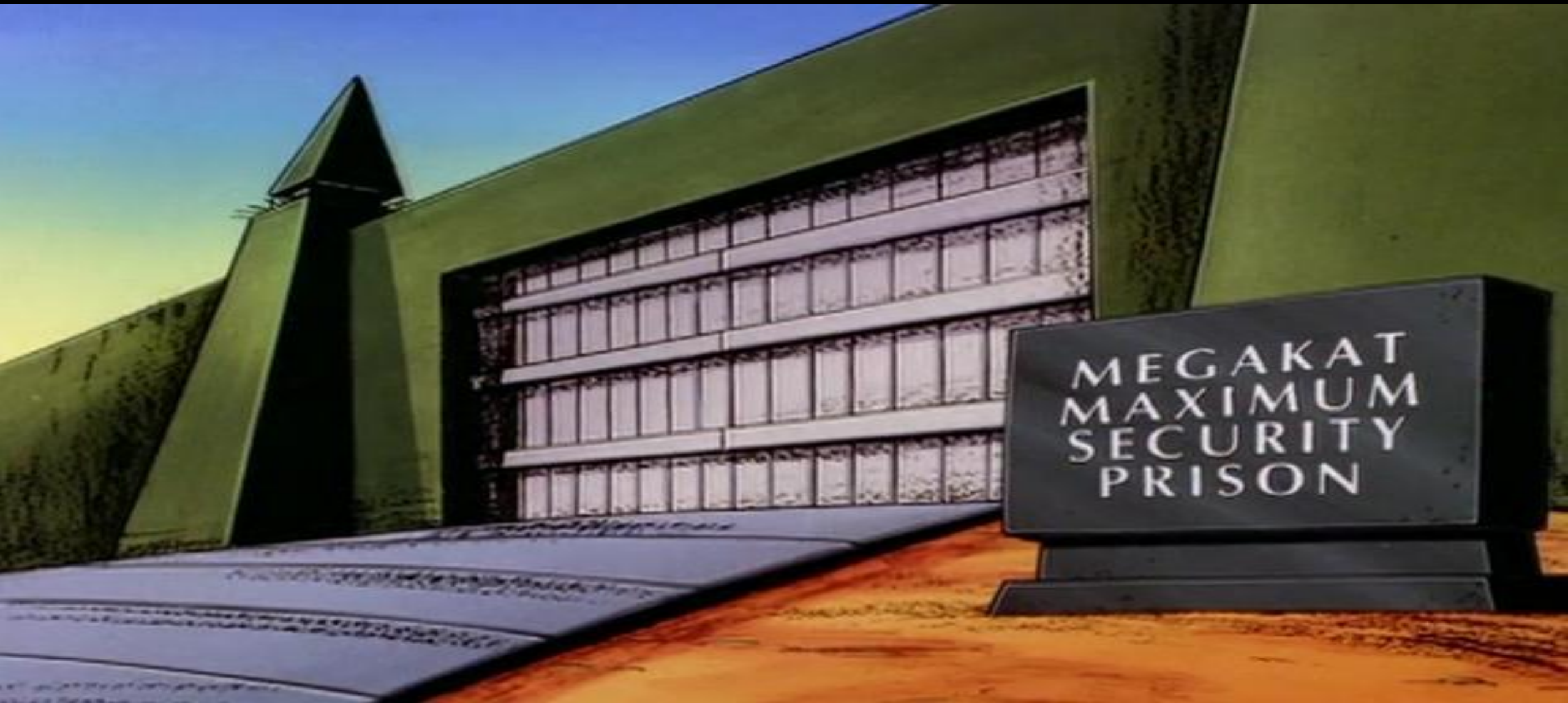
Approach



Final Results



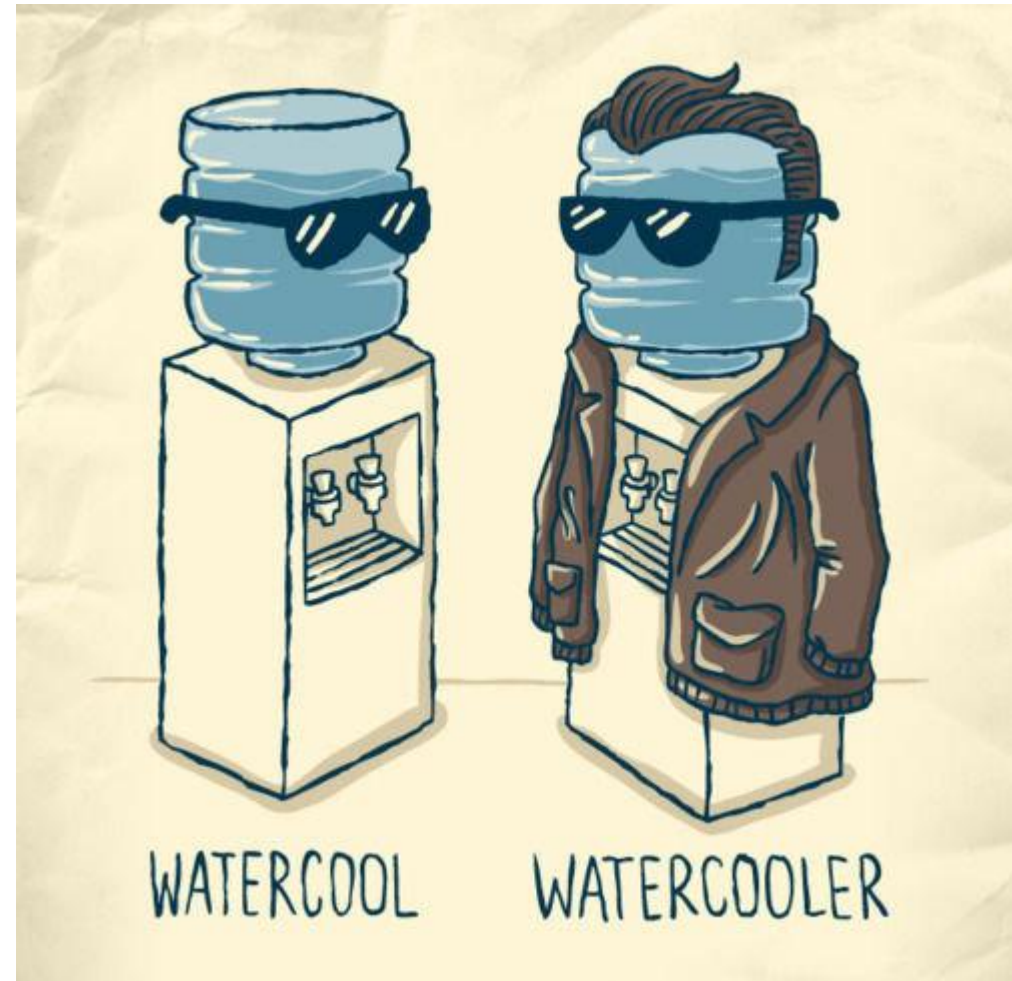
What's next?



**Thank you for
your attention**

Keeping it cool

- Temperature management
- Liquid cooler
- Closed air circulation
- Isolation from environment



Cooling System Slow Control

Supervisors :

mgr inż. Marek Peryt

mgr inż. Krystian Rośton

Authors:

Maciej Czarnynoga

Gabriela Moryc

Agnieszka Borucka



**Wydział
Fizyki**

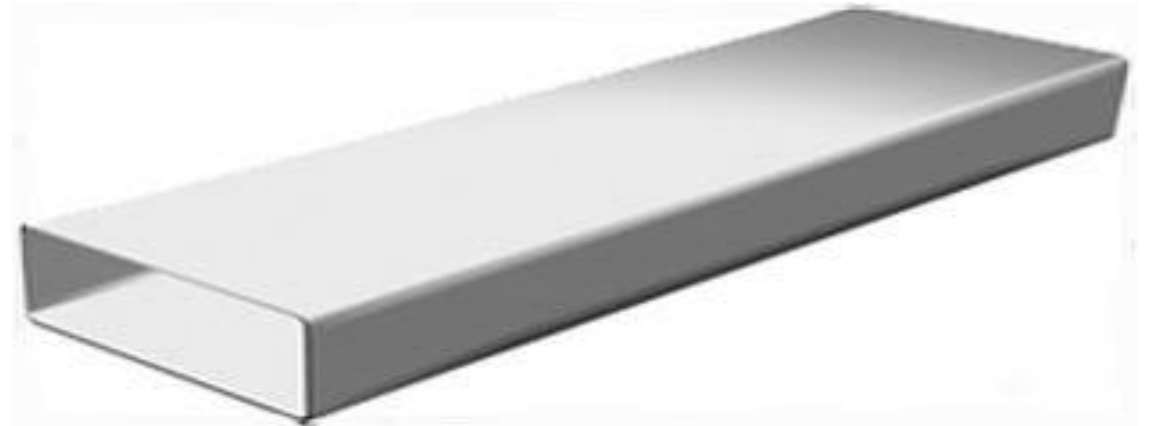
POLITECHNIKA WARSZAWSKA

Table of contents

- Purpose of project
- Hardware
- Assembly project
- Interface of program
- Block diagram

Purpose of project

Creating a system which allows an easy opening and closing of the air circulation inside a ventilation duct.



Hardware

Servo machine HS-311 Hitec



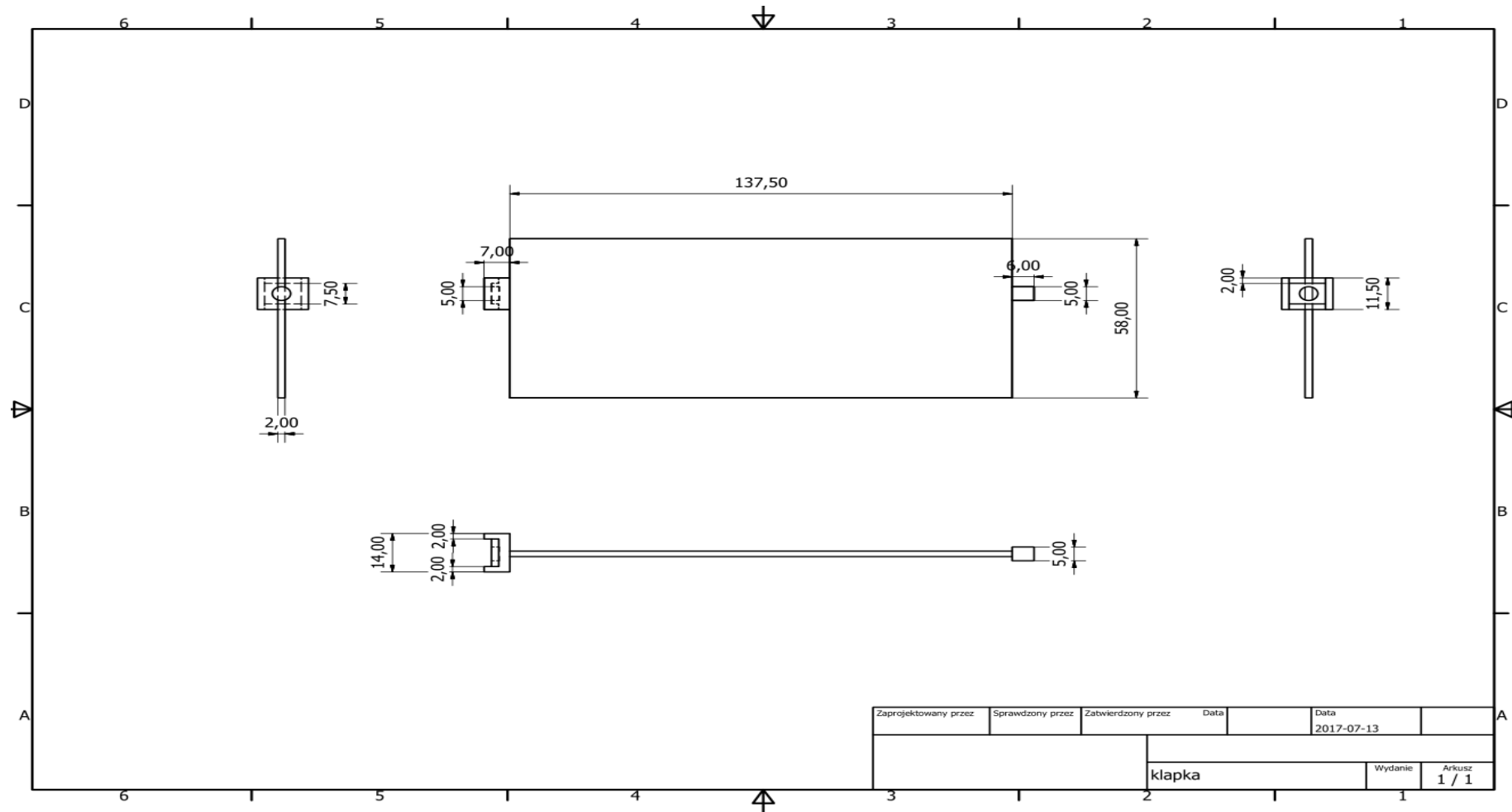
Hardware

National Instruments myRIO



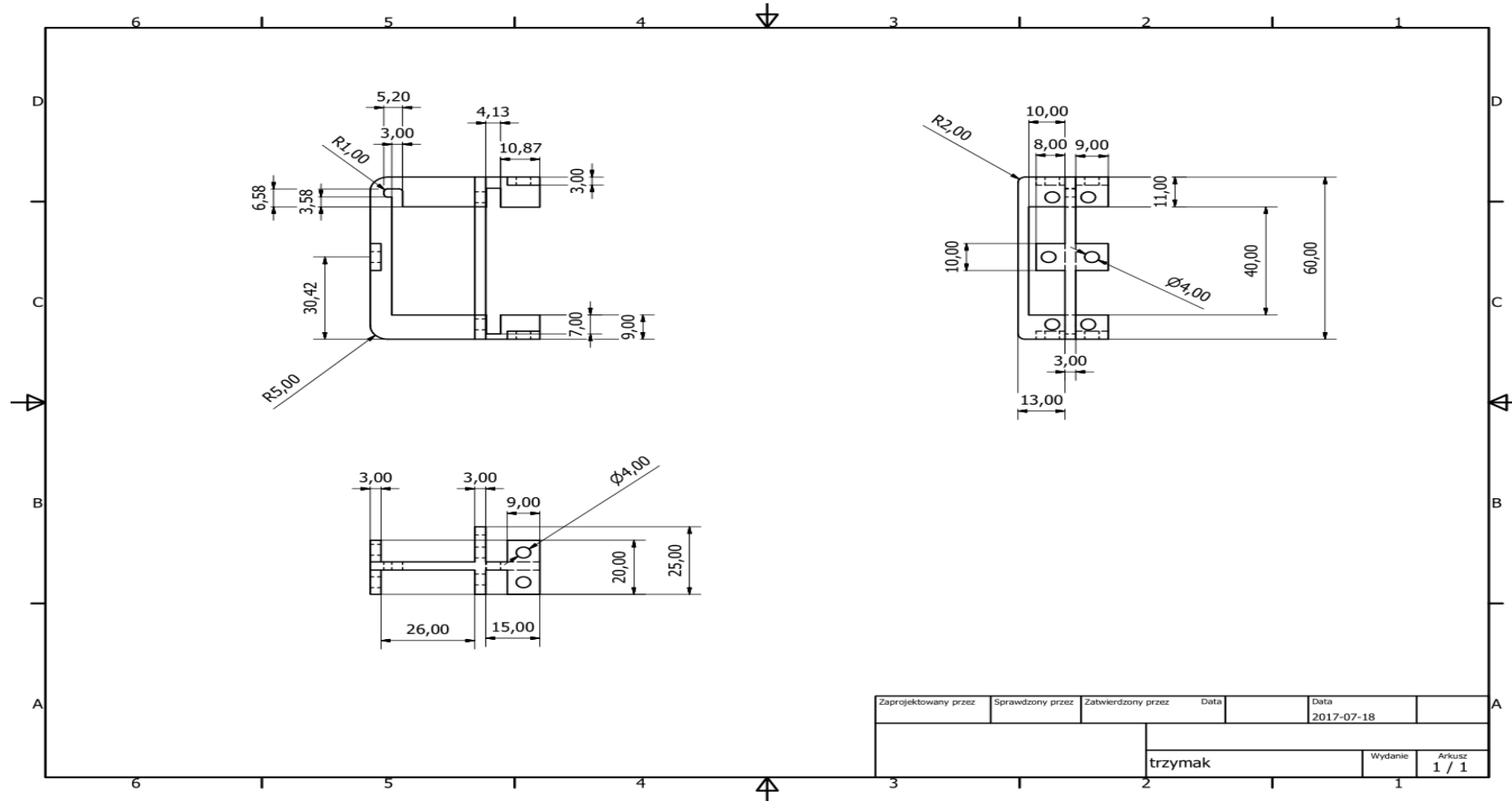
Assembly project

Version 1



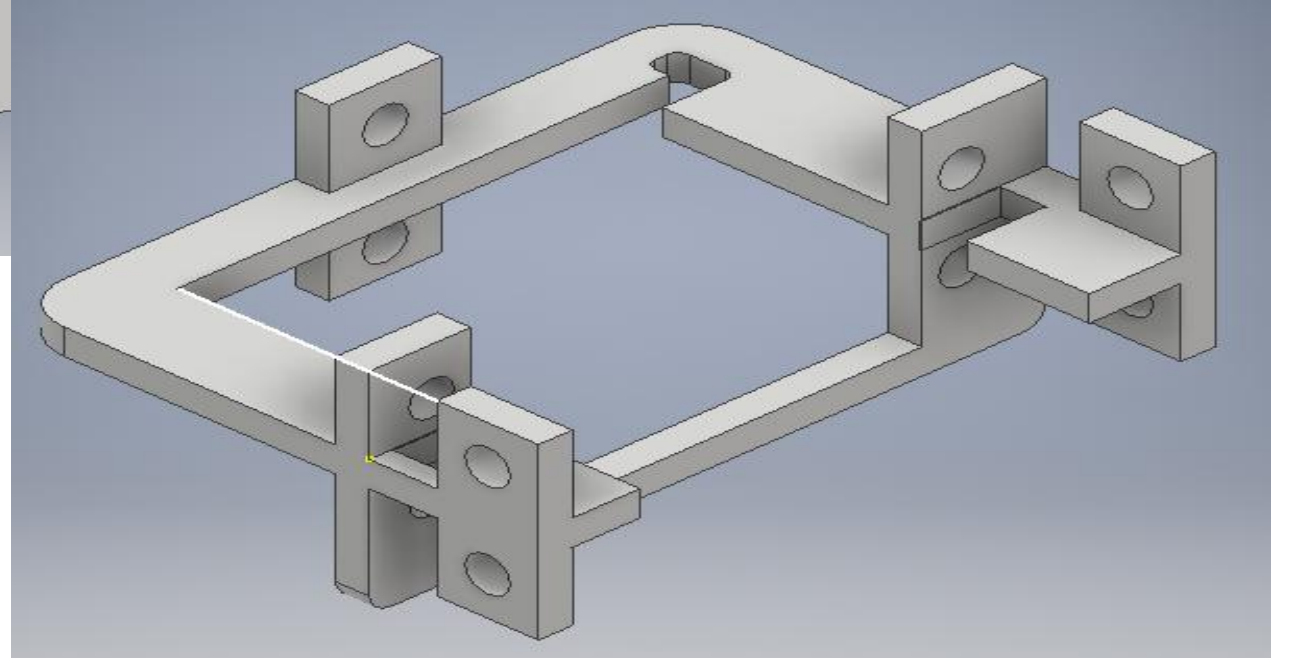
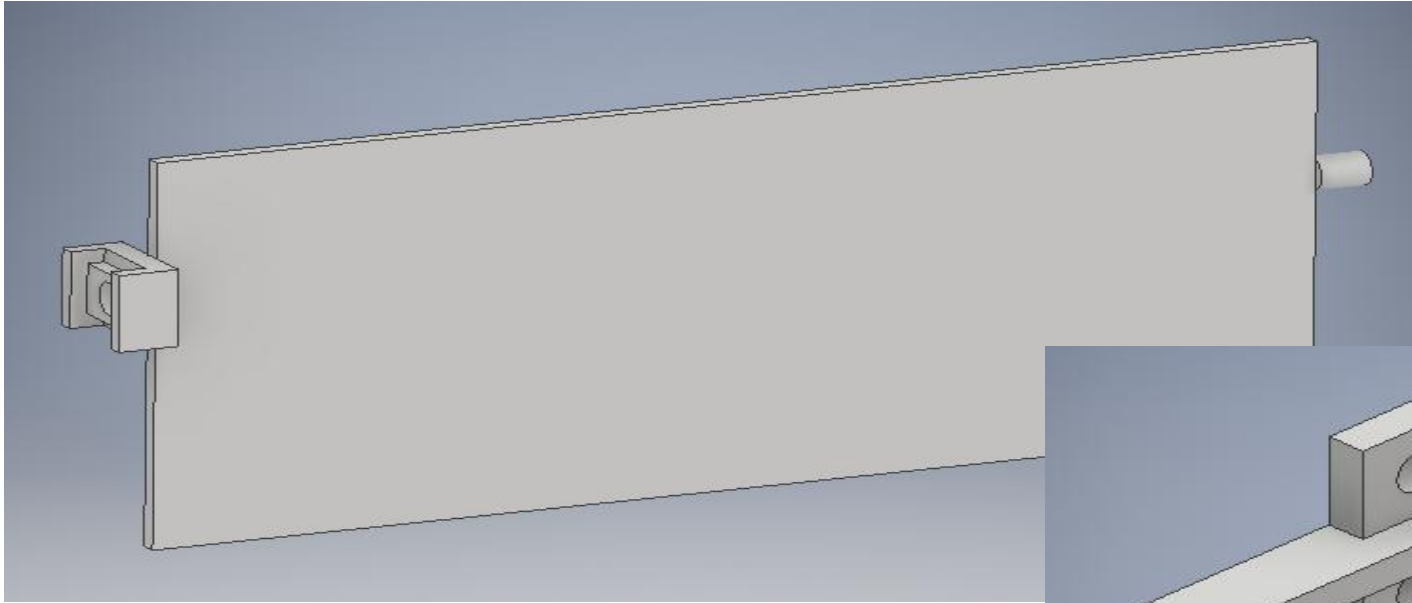
Assembly project

Version 1



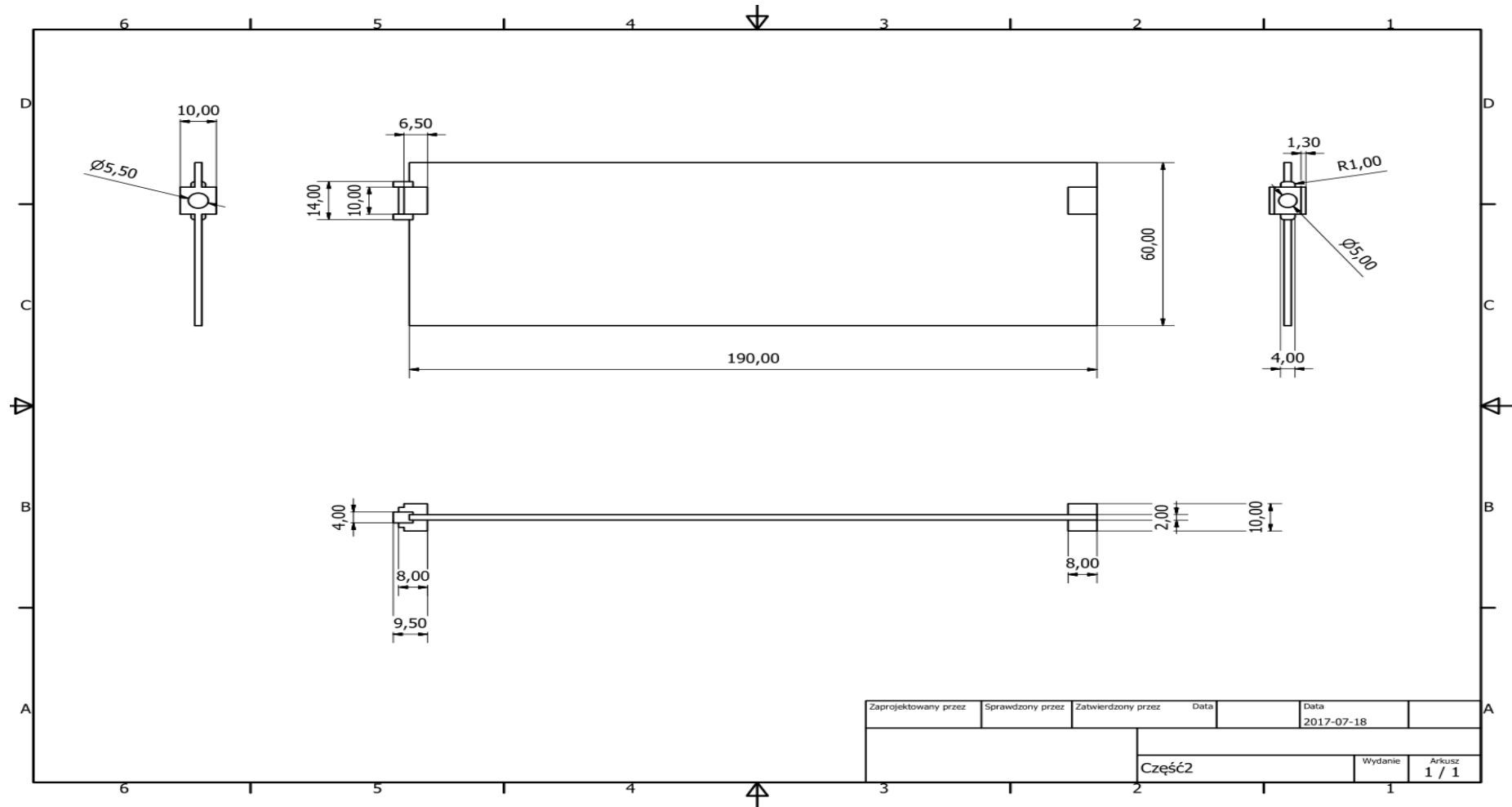
Assembly project

Version 1



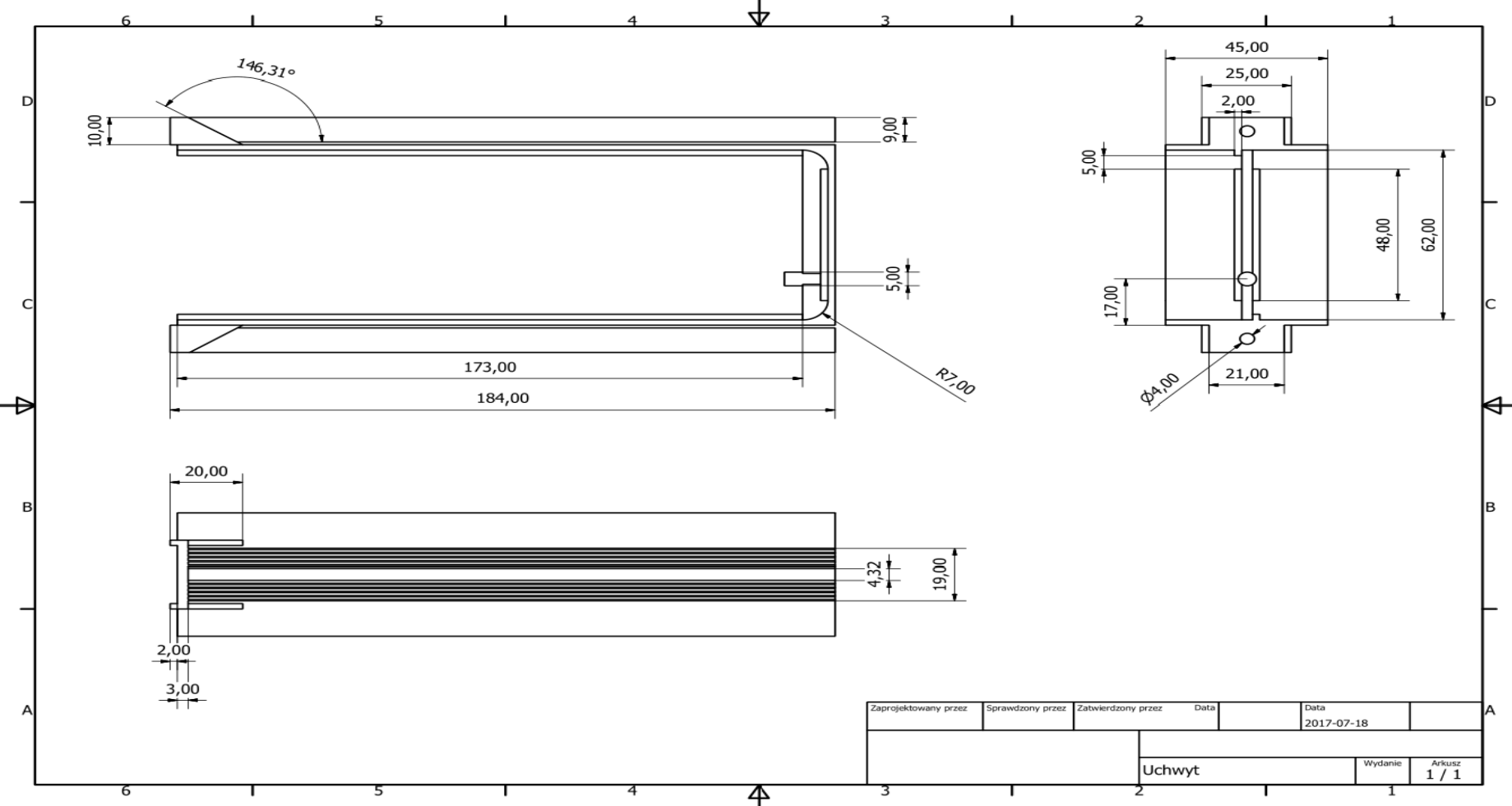
Assembly project

Version 2



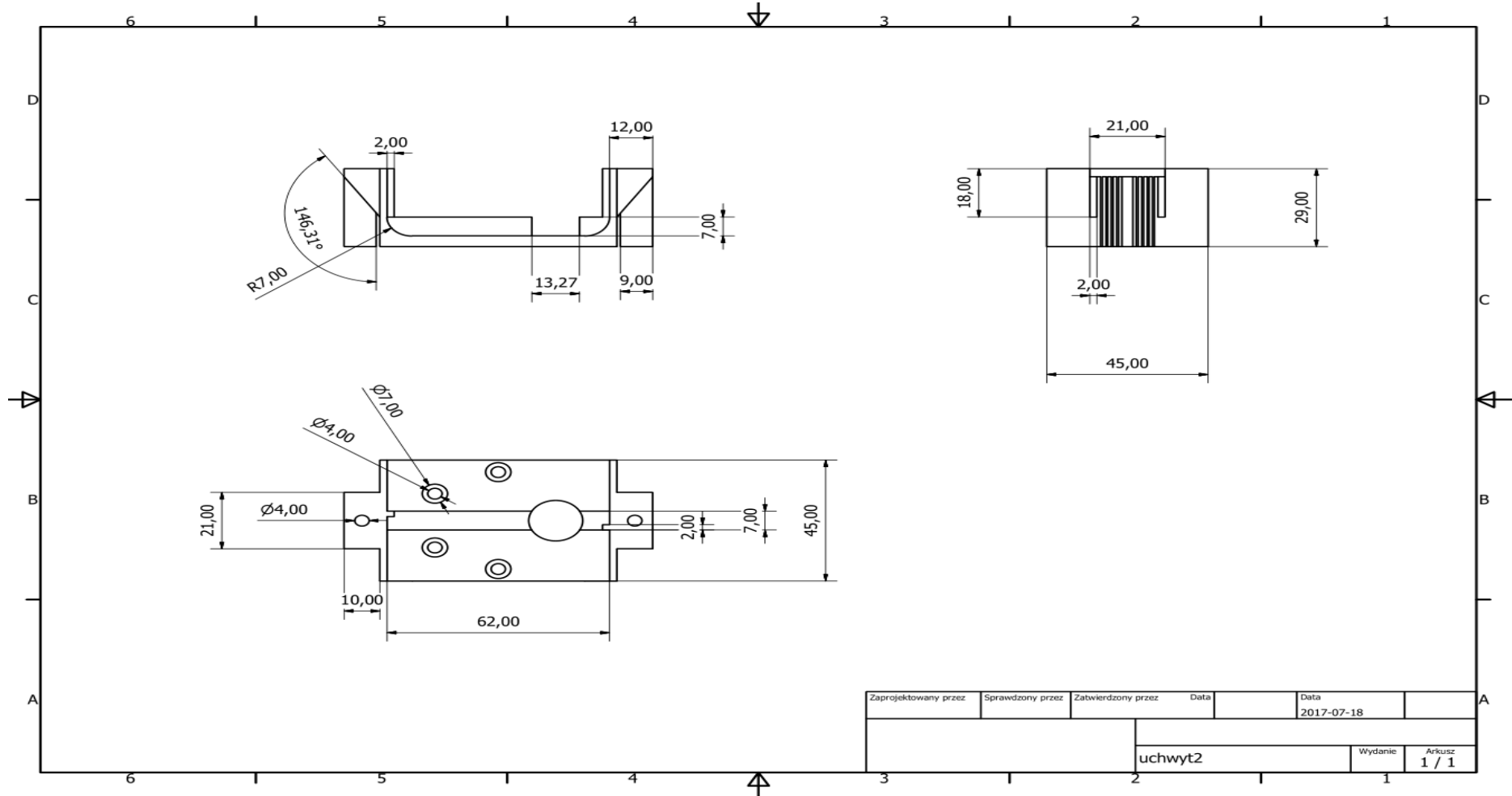
Assembly project

Version 2



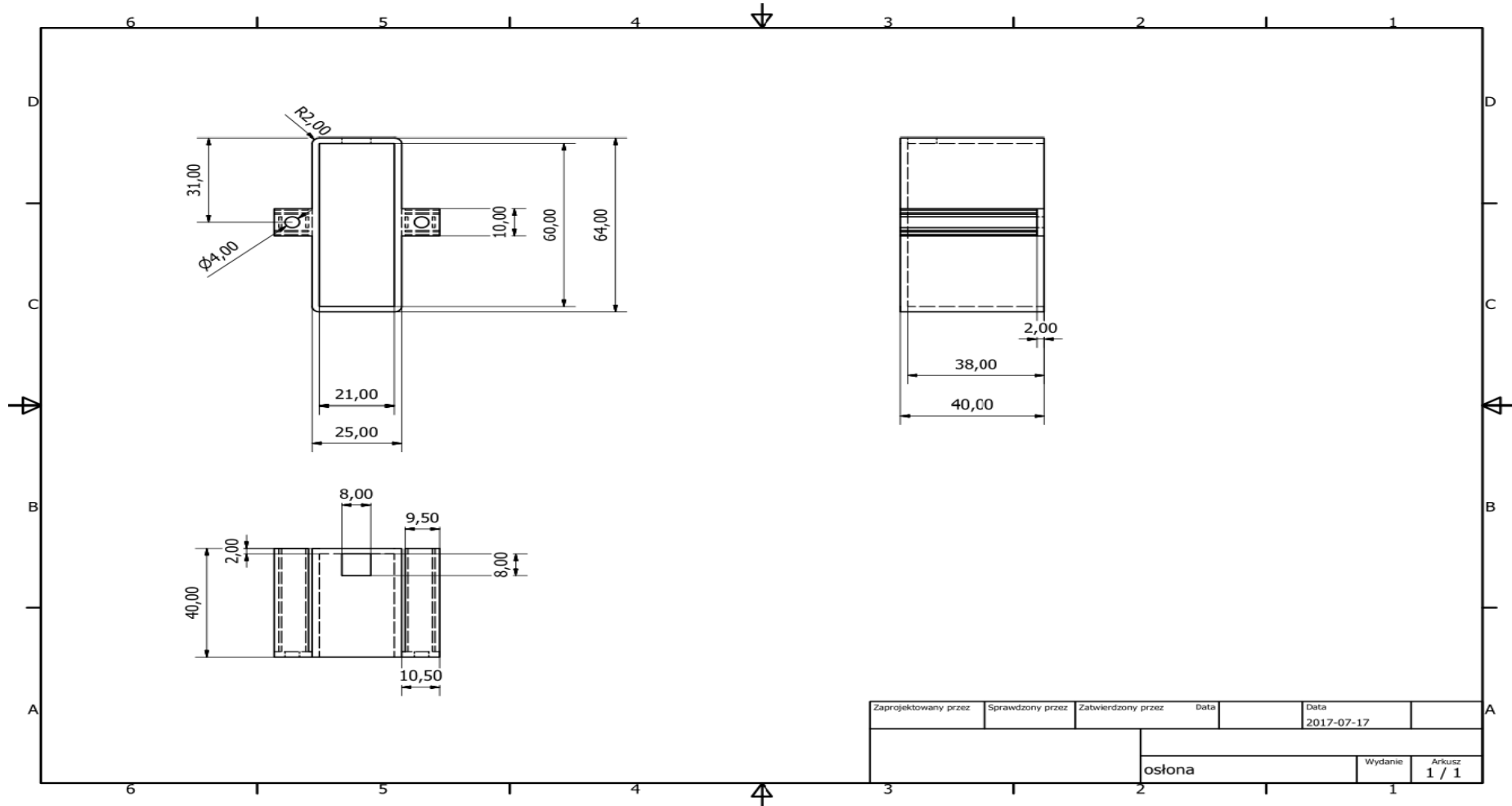
Assembly project

Version 2



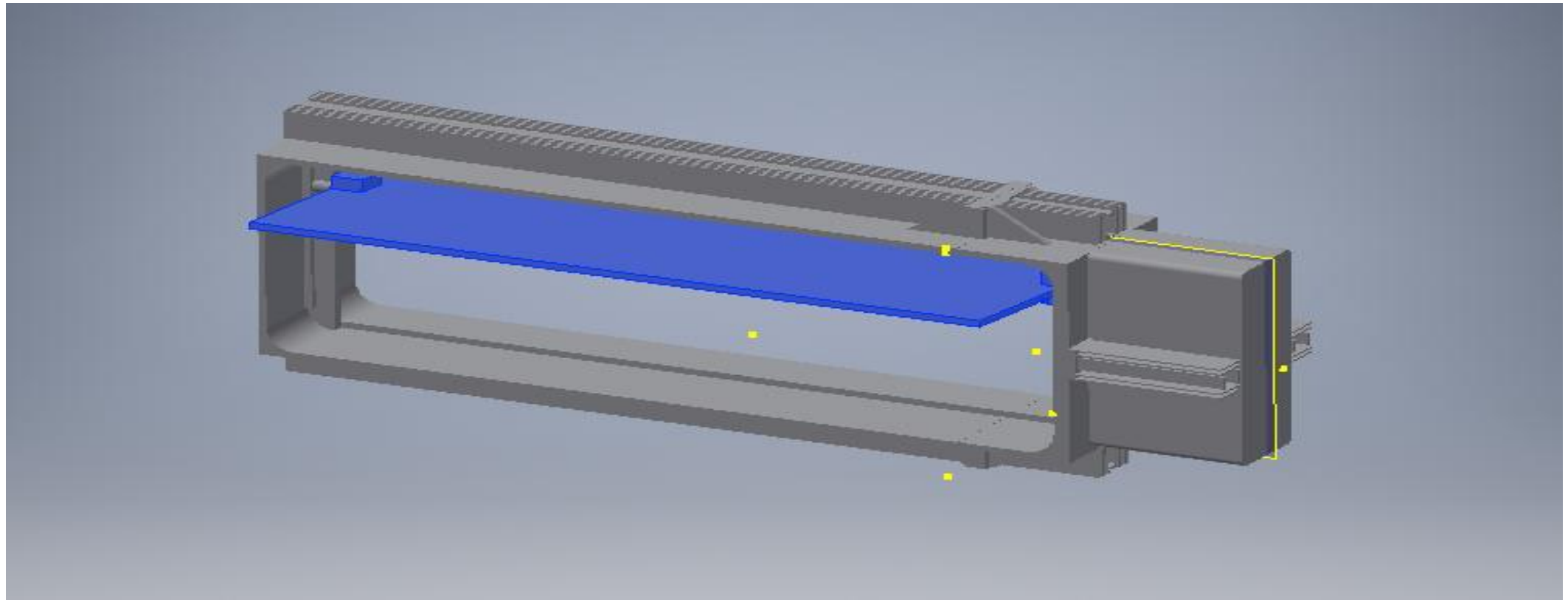
Assembly project

Version 2



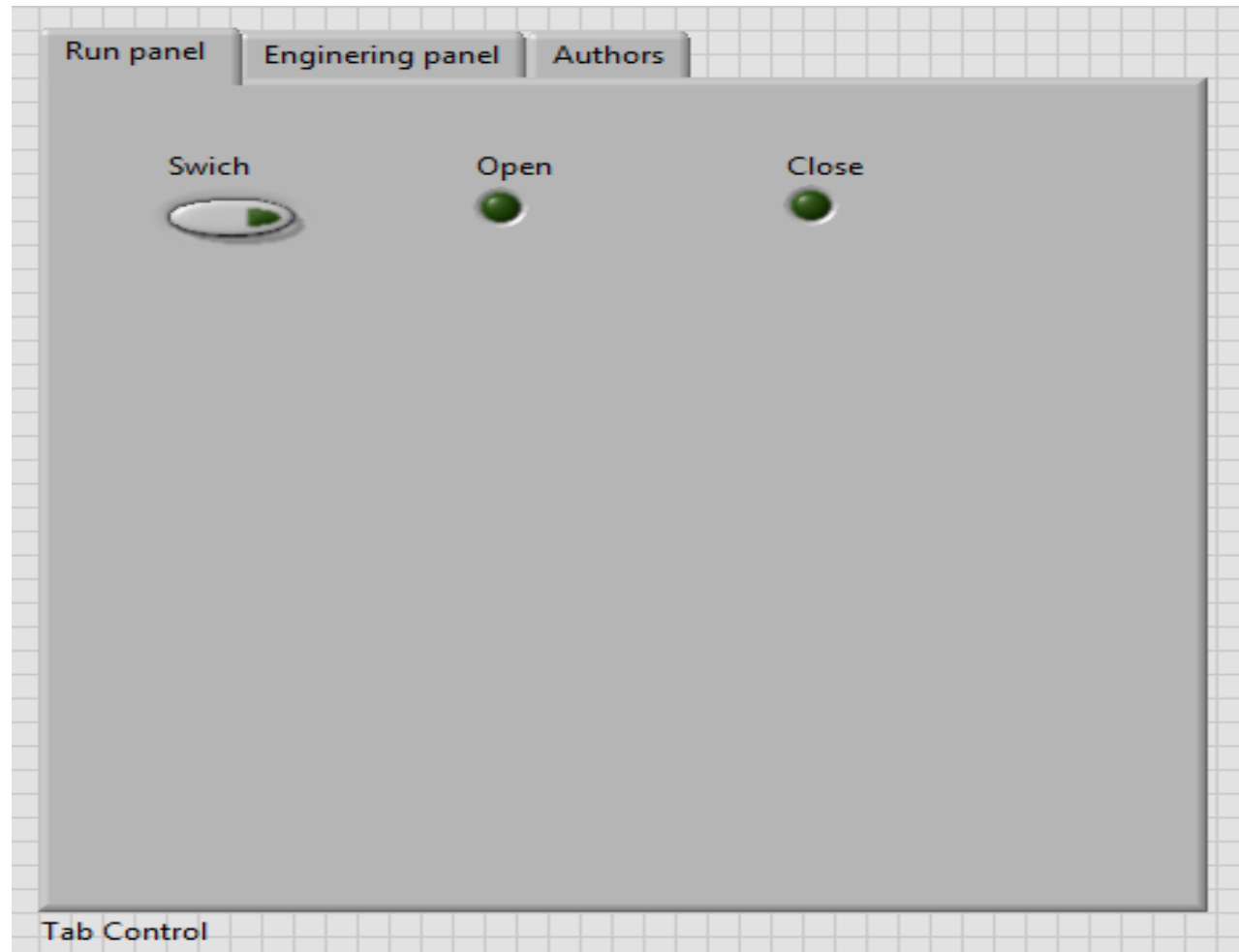
Assembly project

Version 2



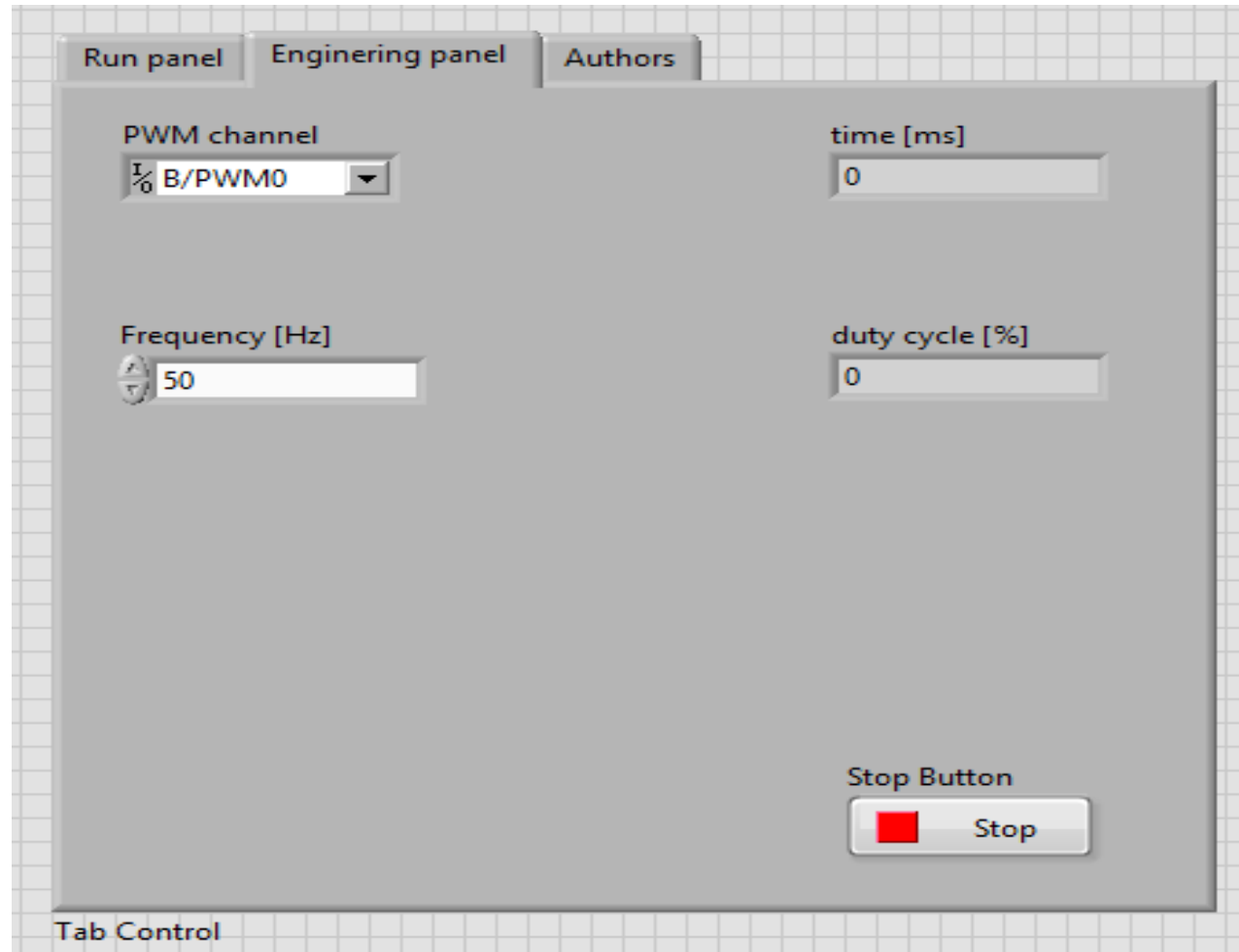
Interface of program

Run Panel



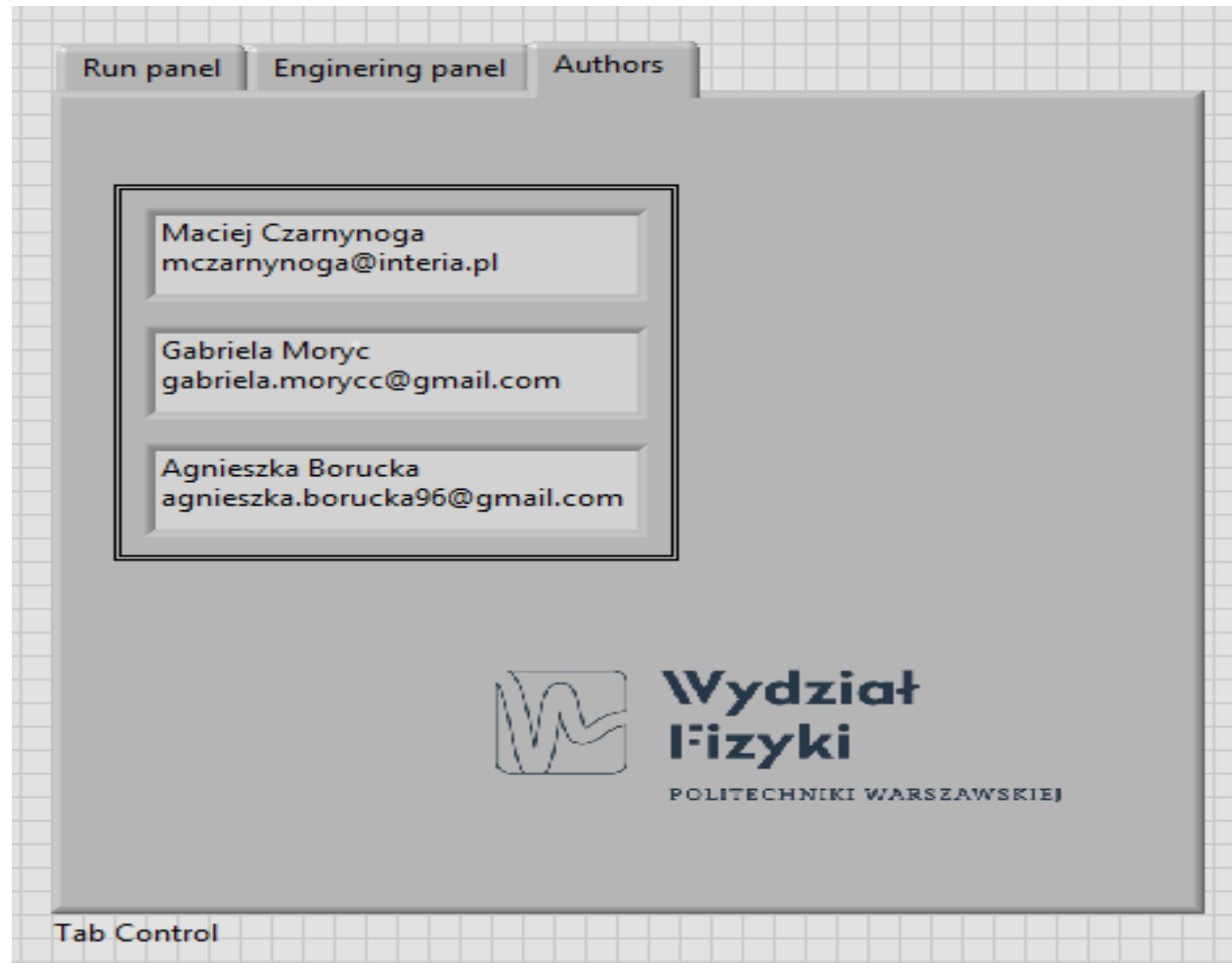
Interface of program

Engineering Panel

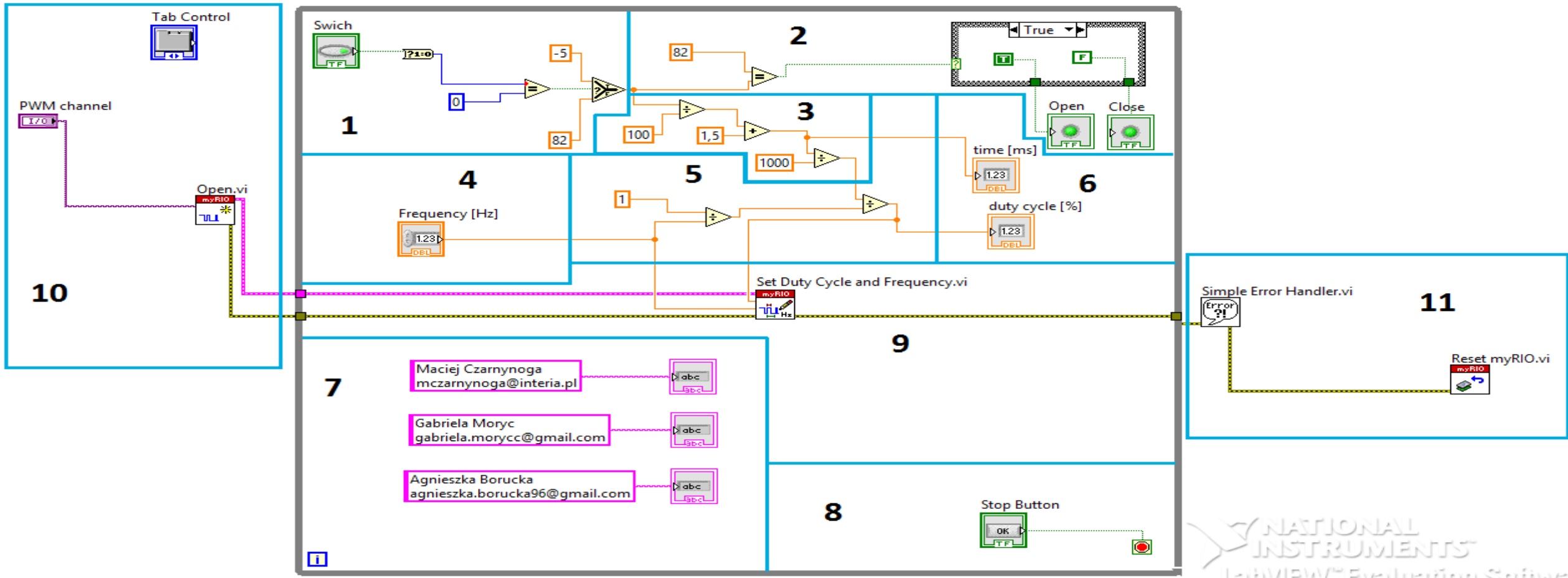


Interface of program

Authors Panel



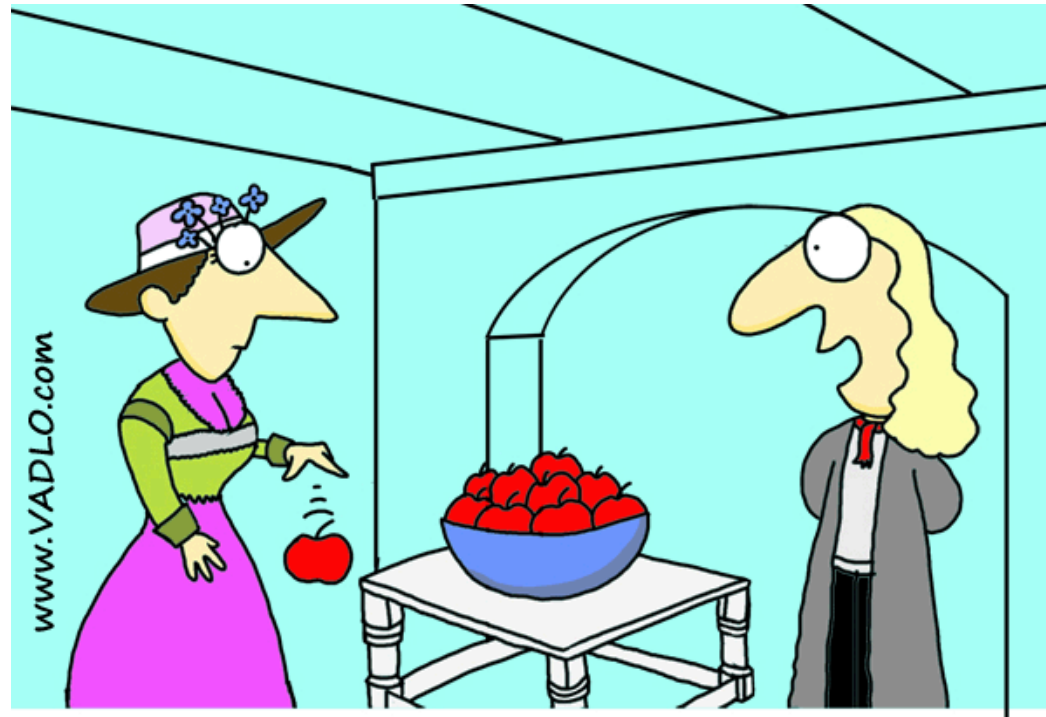
Block diagram



Summary

Our system is a part of cooling system for MASTER RACK and its future work will depends on data from ventilation panel – the project from previous Slow Control program.

Thank You



"Told you!"