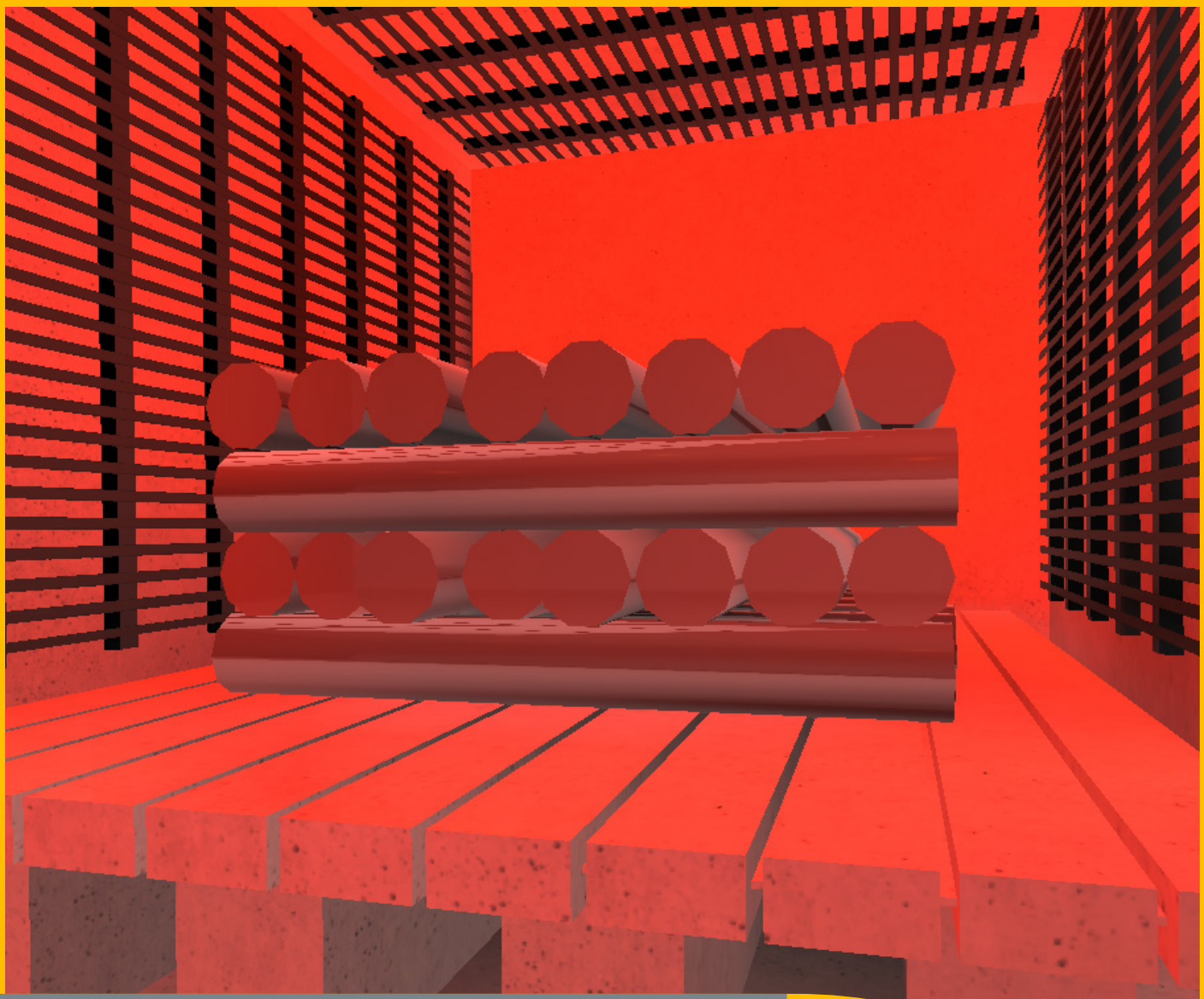


SMARTSIM

DL SMART–DCS

DYNAMIC CONTROL SYSTEMS COURSE

DE LORENZO

SMART SIMULATOR FOR LEARNING CONTROL WITH PLC

The DL SMART-DCS is a software that has been developed to teach dynamic control with PLC in a unique and effective way.

With this software, students can improve their individual experience on studying control systems in practice.

Professors can explore this trainer to provide experiments to students with the following topics:

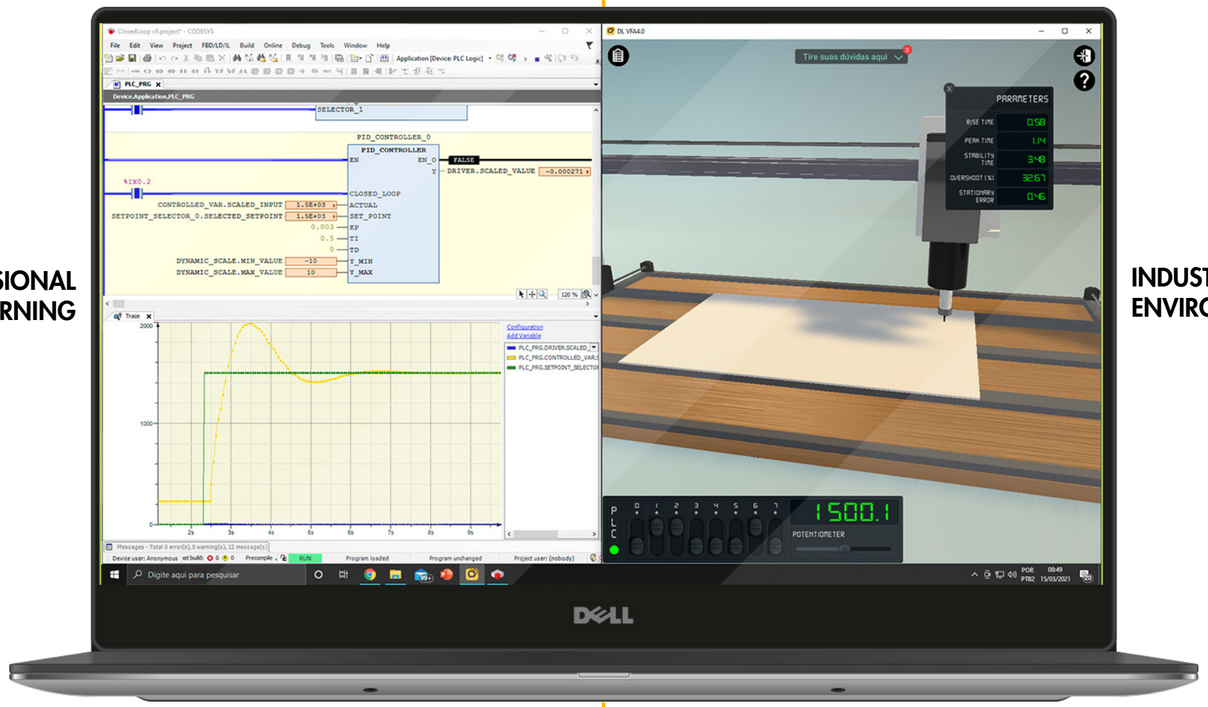
- **Control systems: Introduction, examples, block digrams, open and close loop systems;**
- **Control principles: Mathematical modeling of dynamic systems, linearity, transfer function, block diagrams, frequency response, stability, computational simulation;**
- **Control approaches: Classic, optimal, fuzzy, other approaches;**
- **ON-OFF and PID Control (P, PI, D, PID): Designing and tuning by analytic and experimental methods, and study of the P, D and I control actions;**
- **Analysis of systems of first, second and third order in transitory and steady state.**

This software works integrated to a softPLC (not included) which can be: The Siemens PLCSIM or Codesys Control.

INDUSTRIAL PLC PROGRAMMING TOOLS

POWERFUL 3D SIMULATOR

PROFESSIONAL LEARNING

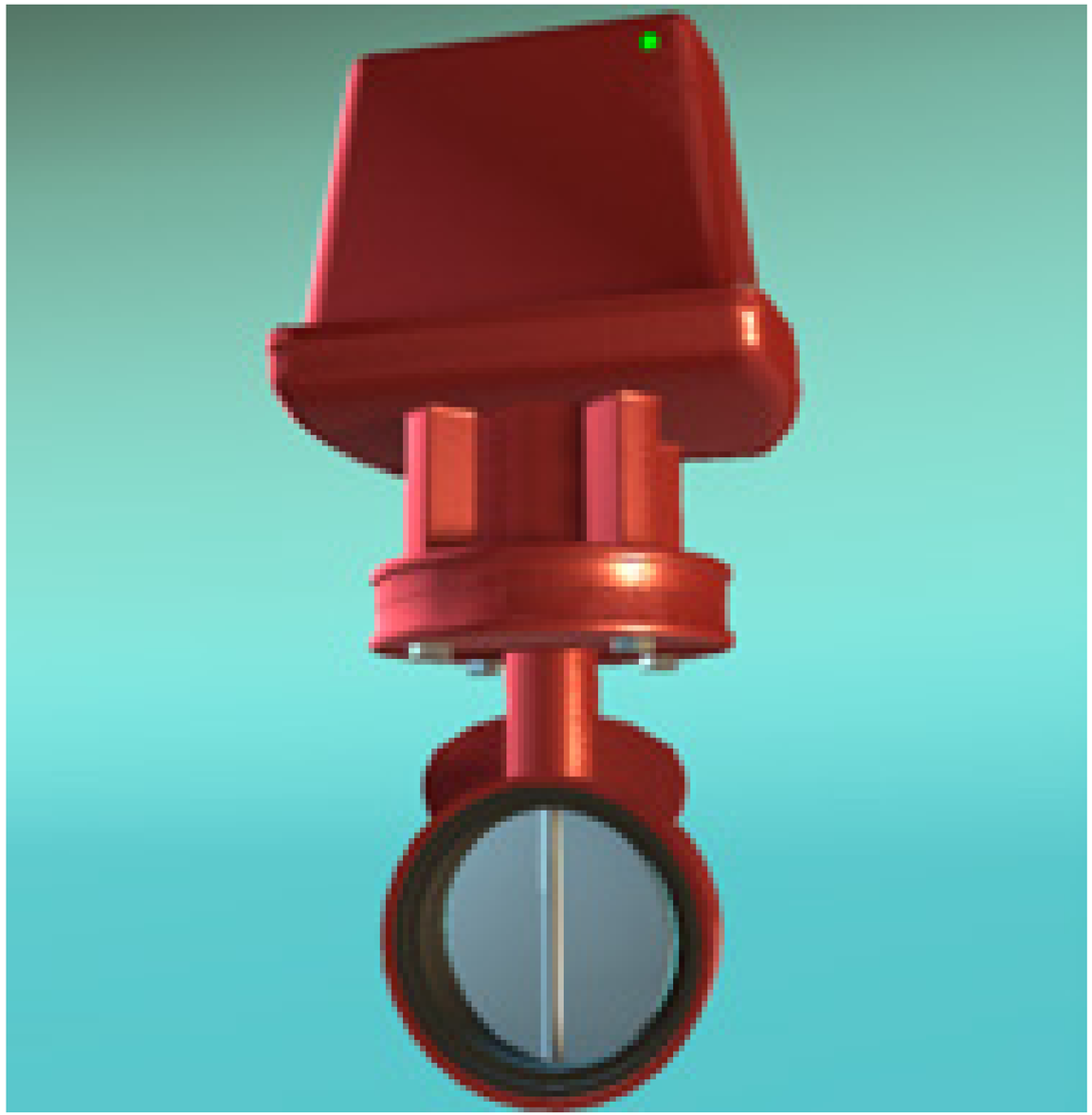


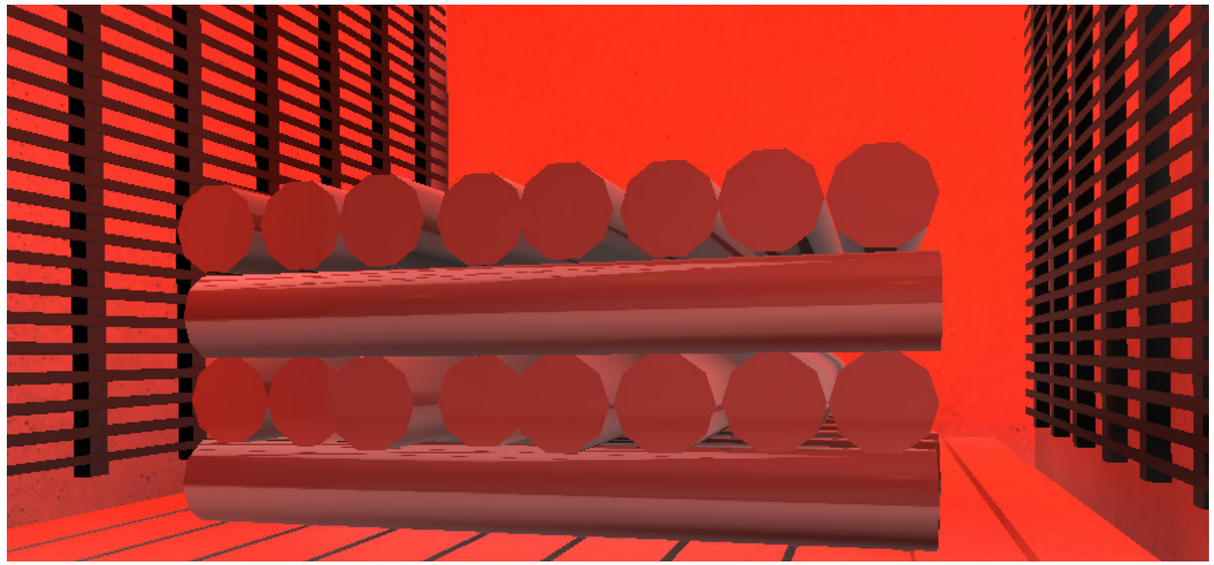
INDUSTRIAL REALISTIC ENVIRONMENTS

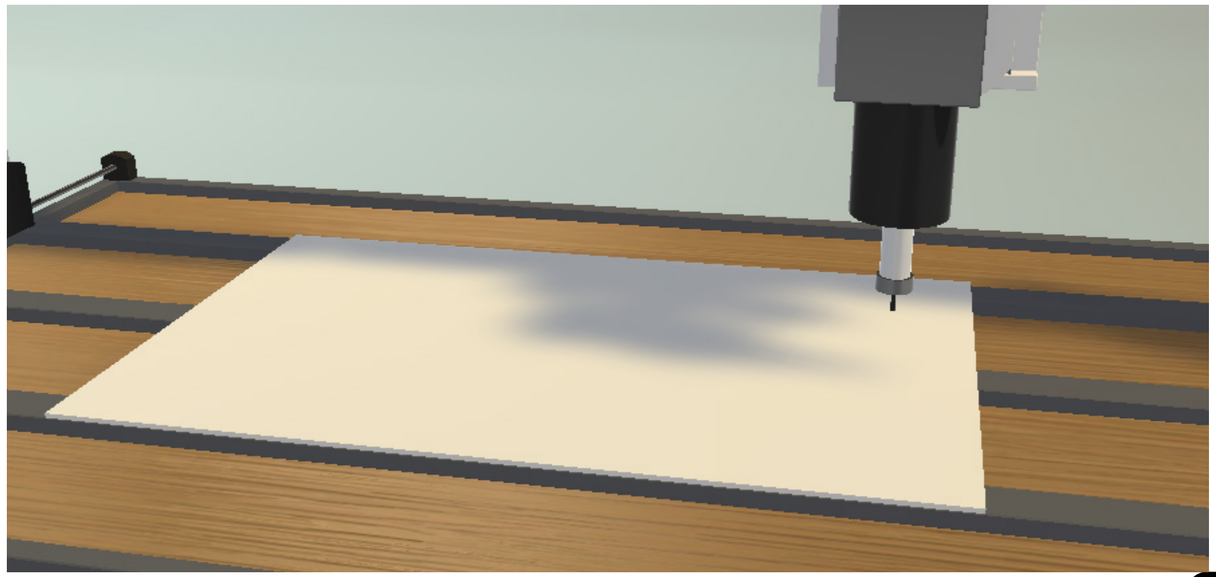
PROFESSIONAL EXPERIENCE

REAL-LIFE SITUATIONS

3D INDUSTRIAL ENVIRONMENTS TO PROVIDE REAL PRACTICAL EXPERIENCE TO STUDENTS

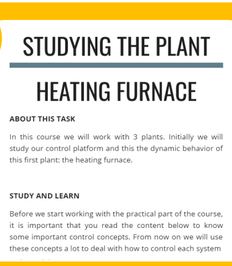






EFFECTIVE LEARNING WITH GUIDANCE, REAL-LIFE PROJECTS, THEORY AND INSTRUCTIONS FROM BASIC TO ADVANCED

1

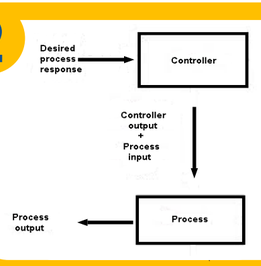


STUDYING AND EXPERIMENTING THE SYSTEMS

Goal: Familiarize the student with basic control concepts and introduce him/her to plants.

Control contents: Studying the plant, control concepts, first steps, communication.

2

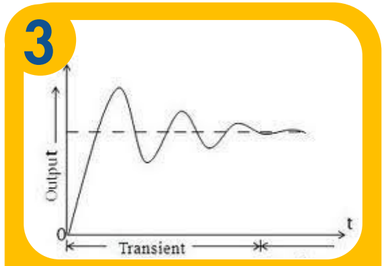


OPEN-LOOP CONTROL

Goal: Implement and discuss a system controlled by the user.

Control contents: Open loop control.

3

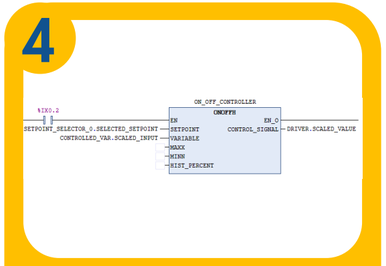


TRANSIENT AND STEADY-STATE RESPONSE

Goal: Study the 2 parts of a response and their importance.

Control contents: System response.

4

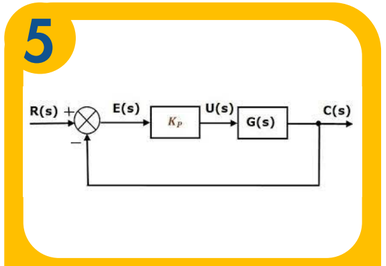


ON-OFF CONTROL

Goal: Implement an on-off controller and evaluate its performance.

Control contents: On-off controller.

5

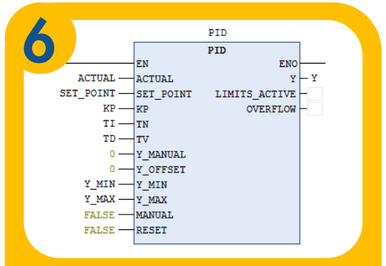


PROPORTIONAL CONTROL

Goal: Implement a proporcional controller and discuss its advantages and limitations.

Control contents: Proportional controller.

6

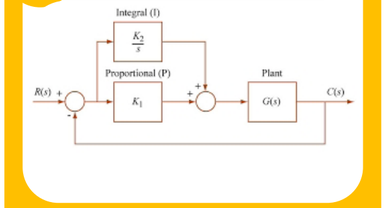


CODESYS PID BLOCK

Goal: Present the Siemens PID controller to be used as a tool from this point on.

Control contents: PID controller.

7

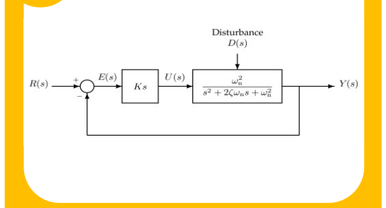


PI CONTROLLER

Goal: Implement a PI controller, present how to tune it, and study the impact of the integral action.

Control contents: PI controller.

8

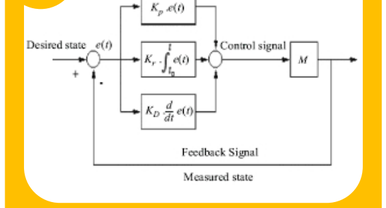


PD CONTROLLER

Goal: Implement a PD controller and study the derivative contribution.

Control contents: PD controller.

9

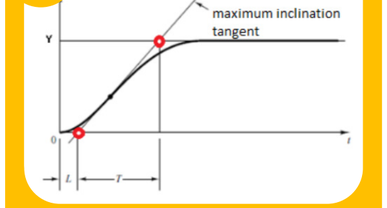


PID CONTROLLER

Goal: Implement a PID controller and study its performance.

Control contents: PID controller.

10

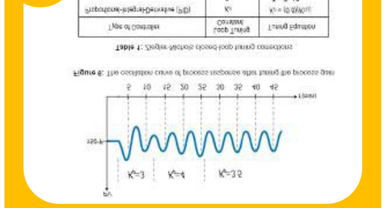


ZIEGLER-NICHOLS METHOD (OPEN LOOP)

Goal: Present and apply the Ziegler-Nichols method to a control system.

Control contents: Ziegler-Nichols (open loop).

11

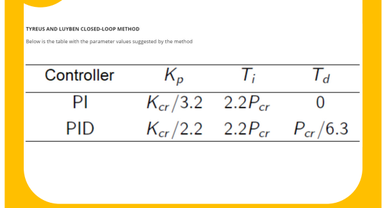


ZIEGLER-NICHOLS METHOD (CLOSED LOOP)

Goal: Present and apply the Ziegler-Nichols method to a control system.

Control contents: Ziegler-Nichols (closed loop).

12



TYREUS AND LUYBEN CLOSED-LOOP METHOD

Below is the table with the parameter values suggested by the method

Controller	K_p	T_i	T_d
PI	$K_{cr}/3.2$	$2.2P_{cr}$	0
PID	$K_{cr}/2.2$	$2.2P_{cr}$	$P_{cr}/6.3$

OTHER PARAMETRIZATION METHODS

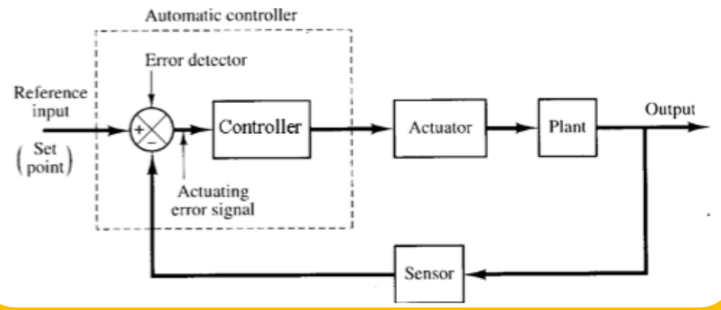
Goal: Study and implement other parametrization methods.

Control contents: Other parametrization methods.

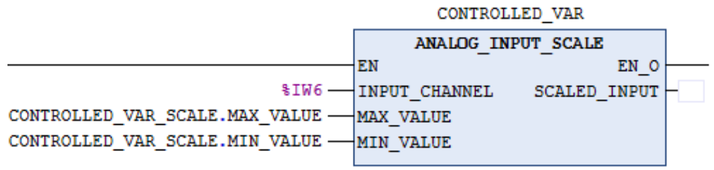
STUDENT CAN LEARN AND PRACTICE FROM BASIC TO ADVANCED
CONTROL TOPICS

With the industrial 3D environments and also the built-in projects it´s possible to develop solutions that evolve basic control approaches, like open loop control, controllers tuning (ON-OFF, P, PI, PD, PID) and some tuning methods, like Ziegler-Nichols closed loop method.

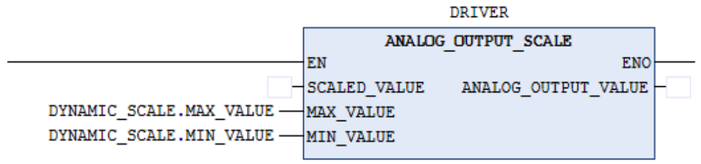
CONTROL CONCEPTS



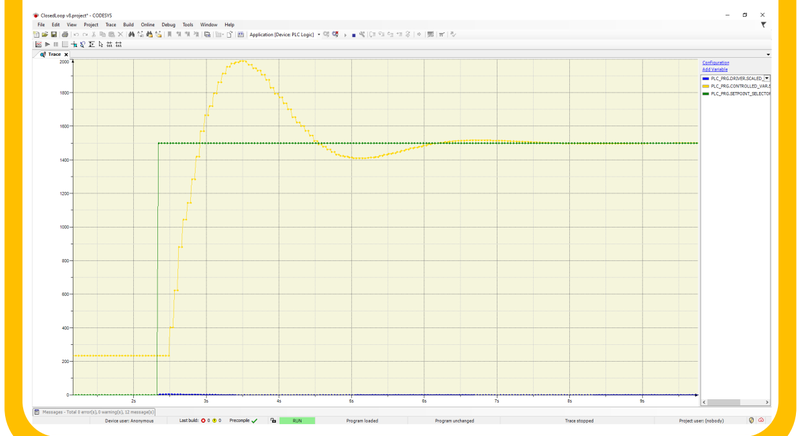
SCALING



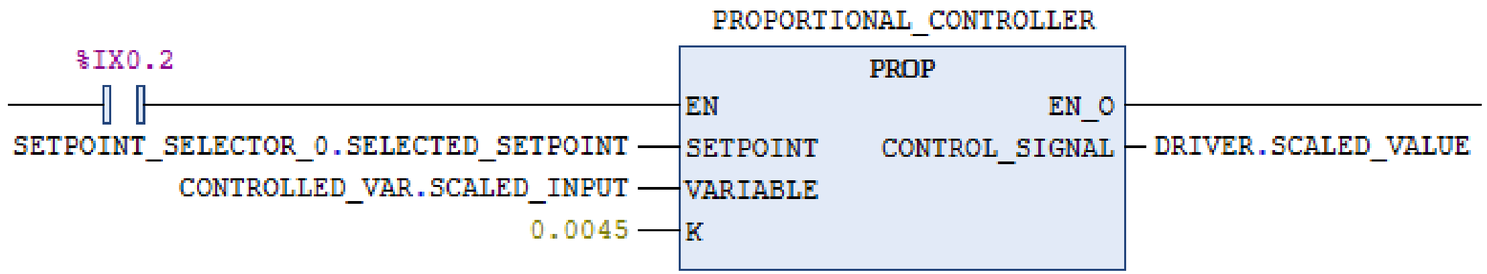
FUNCTION BLOCKS



TRACE



CONTROLLER

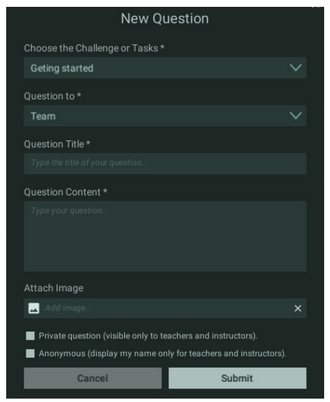


WHY IS IT A SMARTSIM?

IT CONNECTS PROFESSOR, STUDENT AND SCHOOL

De Lorenzo´s cloud server receives students activities and provides reports and analytics to professors and institutions. Besides, a student can start working at school and continue at home or vice-versa.

The platform includes a query and answer system that enables professors to support the students counting on a team of monitors. That means better support with less effort of the professors. The students can see questions asked by other colleagues too so that way if more than one student have the same doubt the professors answer will attend them all.



COMPATIBLE WITH THE DL SMART-DASHBOARD (SOLD SEPARETLY)

PROFESSORS CAN FOLLOW STUDENTS PROGRESS

The professor can do and access everything the student can. Besides, he/she can also access the dashboard's portal. It includes interesting reports and analytics that help the professor to monitor the group in real time, as well as to identify students who are doing very well, as well as those who need help, who are not working at all and who seem to be "cheating".

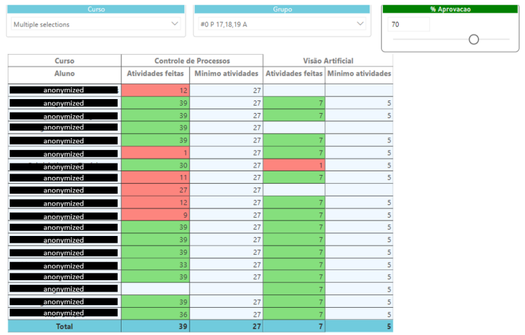
Tasks report

This is an important tool since it provides evidence of the activities a student worked on. That means the school has evidence of the practical activities the distance learner has done with detailed information about it.

Curso	Tarefa	Timestamp	IsDon
Scripts	1.1 - Abrindo uma tela modal	3/9/2020 6:33:37 PM	False
Desenvolvimento de sistemas supervisórios	2.6 - Implementar Gráficos	11/22/2019 7:14:00 PM	False
Desenvolvimento de sistemas supervisórios	2.5 - Montar interface principal	11/18/2019 5:04:15 PM	True
Desenvolvimento de sistemas supervisórios	2.4 - Construindo os objetos da aplicação	11/18/2019 4:28:54 PM	True
Desenvolvimento de sistemas supervisórios	2.3 - Explorando Recursos	11/15/2019 5:35:44 PM	True
Desenvolvimento de sistemas supervisórios	2.2 - Conhecendo o Elipse E3	11/15/2019 5:10:00 PM	True
Desenvolvimento de sistemas supervisórios	2.1 - Comunicação OPC	11/14/2019 12:57:42 PM	True
Desenvolvimento de sistemas supervisórios	1.8 - Comandos pelo supervisório	11/14/2019 11:25:14 AM	True
Desenvolvimento de sistemas supervisórios	1.7 - Implementando alarmes	11/8/2019 7:33:30 PM	True

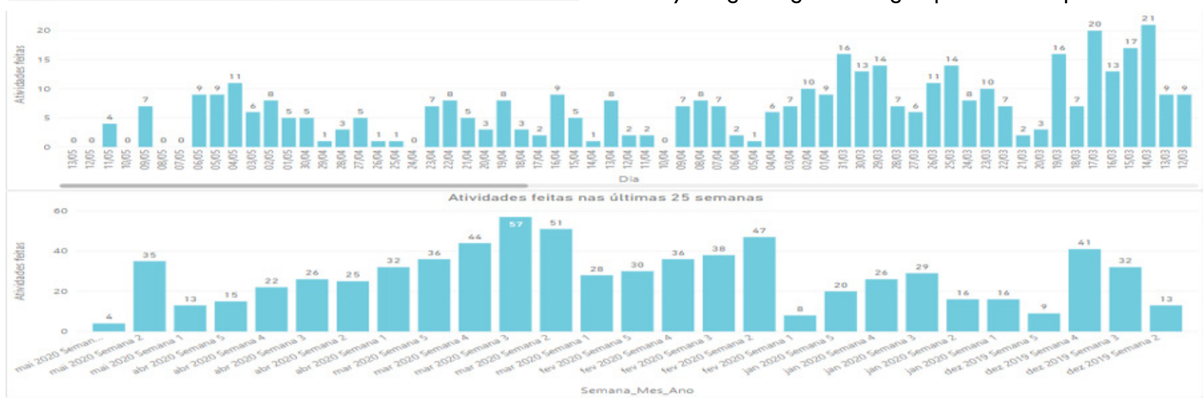
PROFESSOR CAN SEE WHICH STUDENTS ARE ON SCHEDULE

With this interface, the professor may choose which groups he/she wants to monitor, to verify who is on schedule, who is pending and so on. It is possible to define the expected progress percentage in relation to the tasks available in the course.



RHYTHM

This other dashboard shows the number of activities the students did daily and weekly. The professor may decide to verify it regarding a whole group/class or a specific student.



EFFORT/TASK DEDICATED TIME

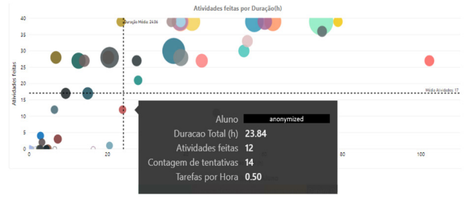
If the professor selects a student, he/she may verify how much time the student took to develop and deliver each task of the course.

Tempo por tarefa

Tarefa	Duracao Total (h)
Controlador ON-OFF - Forno	4.33
Estudando a Planta - Forno	4.08
Controlador PI - Forno	3.14
Resposta transiente e estacionária - Forno	2.50
Estudando a planta - Fuso	2.45
Métodos de Ziegler-Nichols(Malha Fechada) - Forno	2.35
Controlador PD - Forno	1.99
Controlador ON-OFF - Válvula	1.88
PID Siemens - Forno	1.63
Controlador Proporcional - Forno	1.44
Controlador PI - Válvula	1.42
Métodos de Ziegler-Nichols(Malha Aberta) - Forno	1.29
Estudando a planta - Válvula	1.22

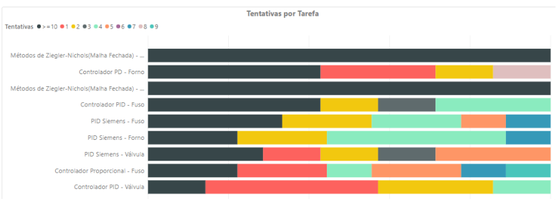
PROGRESS VS TIME TAKEN

It is also possible to verify the distribution of the dedicated time with relation to the number of tasks done by each student at any period of time. That helps to identify who is doing well, who may need help, who is doing nothing and who is trying to cheat.



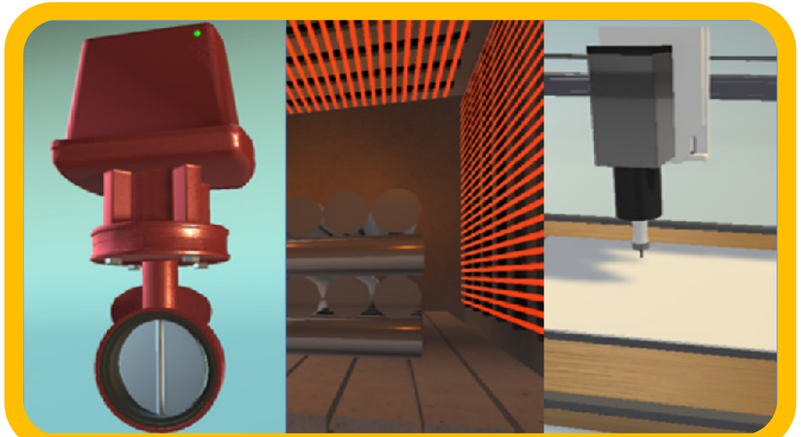
TRIALS PER TASK

This chart helps the teacher to understand which task may be the most difficult and which one may be the easiest in order to adjust the deadlines.



SUMMARY OF FEATURES

IT'S A 3D SIMULATOR



IT HAS BUILT-IN PROJECTS

PLANT 1 - HEATING FURNACE

It's a heating furnace for materials with heating capacity up to 1000 degrees. Thermal systems exist in almost all industries. In our plant the heating takes place by Joule effect. A resistance bank is controlled by a power drive that receives an analog signal from 0 to 10VDC. The temperature of the sensor goes from 0 to 1000 degrees. The cooling is obtained by natural means. By nature it is a slow plant. In our virtual plant it will be faster than normal, because otherwise you would take hours to do a task.

For this task you must have Codesys installed on your

THE PROJECTS INCLUDE GUIDANCE

TASK SPECIFICATION

With the furnace plant open at the VFA wait for the LED indicating communication with the PLCSim turn green and:

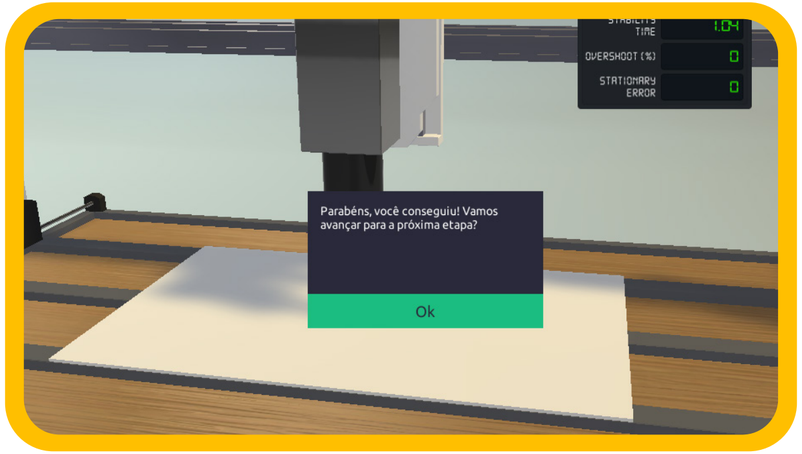
1. Activate the buttons of the two selector bits (0 and 1);
2. Move the potentiometer and check the effect of the control signal that you are producing in the controlled quantity;
3. Confirm the minimum and maximum values of the control signal obtained at the ends of the potentiometer;
4. Confirm the minimum and maximum values of the controlled magnitude;

+ CONTENTS AND SUPPORT MATERIALS, SO THEY CAN LEARN BY THEMSELVES

Control contents:

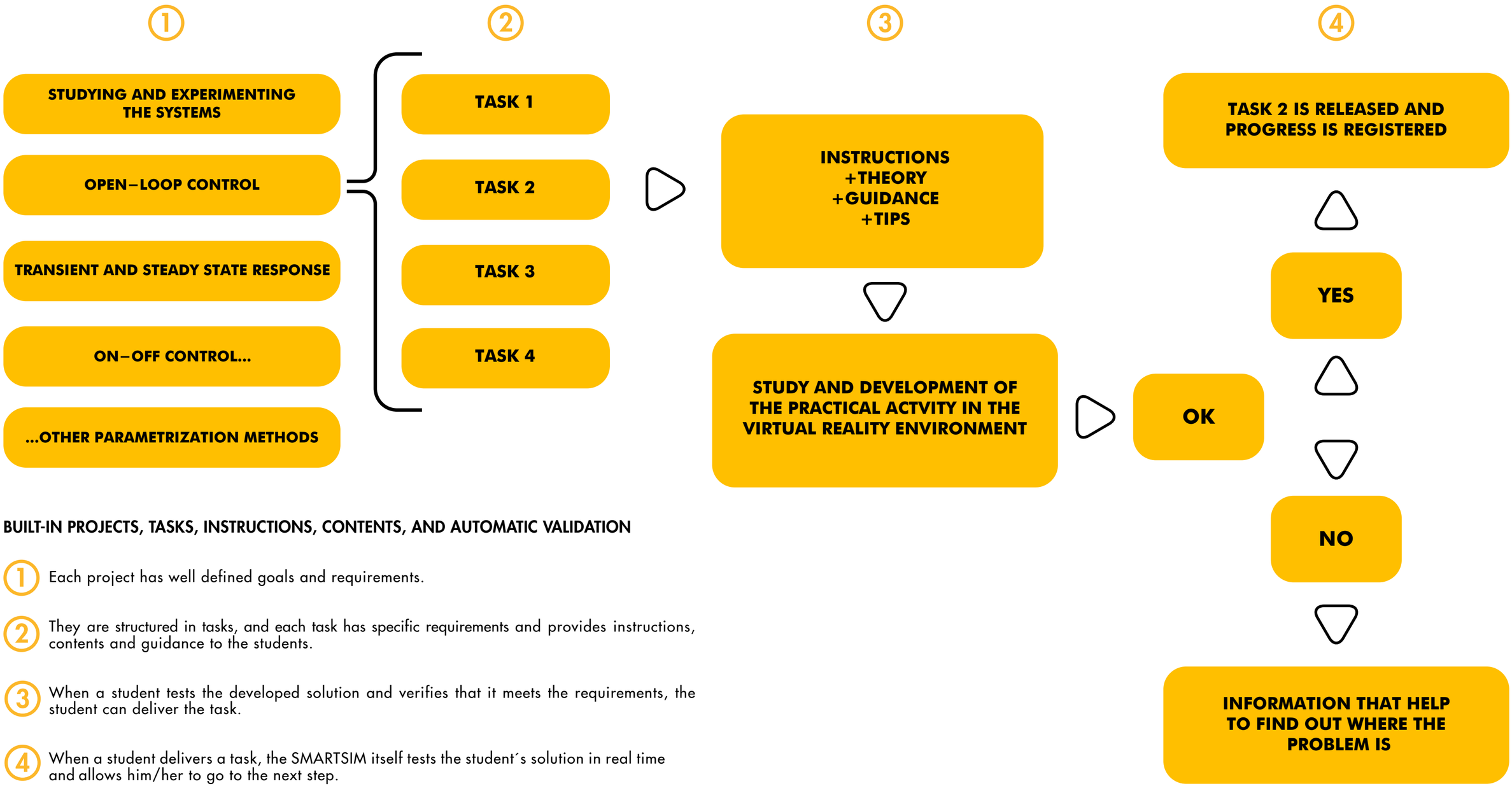
- Control concepts
- Open vs closed loop
- Excitations in a Plant
- Transient and steady state response
- ON-OFF control

IT AUTOMATICALLY CHECKS STUDENT ACTIVITIES TO LET THEY MOVE ON, LIKE IN GAME



PROFESSORS CAN MONITOR STUDENTS, AND VERIFY WHICH POINT THEY NEED HELP (Option available with Dashboard)

HOW ARE BUILT-IN PROJECTS STRUCTURED?



BUILT-IN PROJECTS, TASKS, INSTRUCTIONS, CONTENTS, AND AUTOMATIC VALIDATION

1. Each project has well defined goals and requirements.
2. They are structured in tasks, and each task has specific requirements and provides instructions, contents and guidance to the students.
3. When a student tests the developed solution and verifies that it meets the requirements, the student can deliver the task.
4. When a student delivers a task, the SMARTSIM itself tests the student´s solution in real time and allows him/her to go to the next step.

SYSTEM REQUIREMENTS

ORDER CODES

DL SMART-DCSC

DYNAMIC CONTROL SYSTEMS COURSE FOR CODESYS

DL SMART-DCST

DYNAMIC CONTROL SYSTEMS COURSE FOR TIA PORTAL

DL SMART-DASHBOARD

CLASSROOM MANAGEMENT DASHBOARD FOR SMARTSIMS

IMPORTANT NOTE:

THIS PRODUTS DO NOT INCLUDE ANY THIRD PARTY SOFTWARES SUCH AS TIA PORTAL, PLCSIM, CODESYS OR CODESYS CONTROLWIN.

TO OUR KNOWLEDGE, CODESYS DEVELOPMENT SYSTEM CAN BE DOWNLOADED FOR FREE AT CODESYS STORE.

TIA PORTAL STEP7 + PLCSIM HAVE TRIAL VERSIONS ON SIEMENS WEBSITE. AND AN EDUCATIONAL VERSION CAN BE PURCHASED BY SIEMENS.

MINIMUM REQUIREMENTS

OPERATIONAL SYSTEM

64-BIT WINDOWNS 10

DIRECTX VERSION

DIRECTX 11

PROCESSOR

INTEL i5 9400F OR AMD RYZEN 5 3600

MEMORY

8GB

GHRAPHIC CARD

STORAGE

HDD (1GB)

RECOMMENDED REQUIREMENTS

OPERATIONAL SYSTEM

64-BIT WINDOWNS 10 PRO

DIRECTX VERSION

DIRECTX 12

PROCESSOR

INTEL i7 9700 OR AMD RYZEN 7 3700X

MEMORY

16 GB

GHRAPHIC CARD

NVIDIA GTX 1050 TI 4GB OR RX 550 4GB

STORAGE

HDD (1GB)