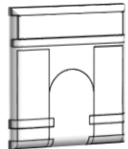


Trained staff on
outcomes and digital oriented
teaching and learning



DECEMBER, 3-6 2024
BENEVENTO, ITALY

Experimental teaching during coronavirus

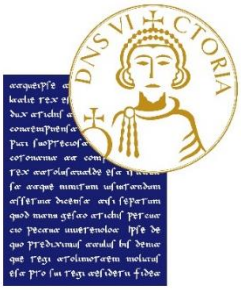
Sergio Rapuano



UNIVERSITÀ DEGLI STUDI
DEL SANNIO Benevento

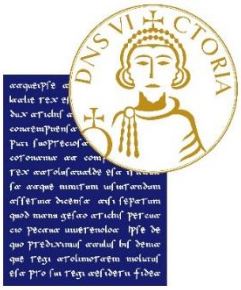


IMPACT OF COVID-19 ON TEACHING



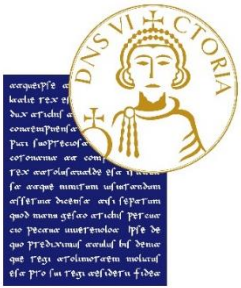
- The COVID-19 outbreak caused a sudden halt in teaching: on March 5, 2020 all the schools and universities were closed. On March 9 the whole Country was put under lockdown.
- The access of staff to the University of Sannio was granted at the own risk of the personnel involved.
- The University reacted very quickly: lectures resumed online after a week.
- Measurement subjects, as many engineering subjects, require extensive laboratory work: how to do it with students at home?

SITUATION AT THE DISRUPTION OF TEACHING

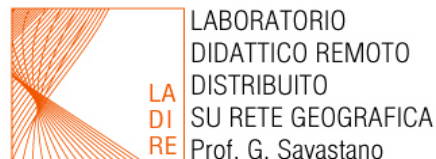


- Five electronic measurement subjects had to be delivered in the second semester of AY 2019-2020, and three had to be delivered in the first semester of AY 2020-2021.
- Subjects to be delivered:
 - Introductory subjects, requiring about 20% supervised laboratory experiments. Between 30 and 60 students.
 - Advanced subjects requiring about 30% supervised laboratory experiments and about 40% laboratory project development. Between 10 and 20 students.
- Available facilities for distance learning:
 - The Didactic Remote Laboratory “G.Savastano” had been operational from 2005.

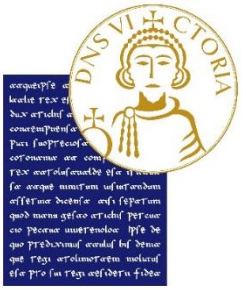
DIDACTIC REMOTE LABORATORY "G.SAVASTANO"



- Project LA.DI.RE. Didactic Remote Laboratory Distributed over Wide Area Network
- Goals: to solve instrument availability limitations, to reach more engineering students, and to provide life long learning on engineering subjects
- Target: to search a new technology to allow distance learning of electronic measurements on actual experiments (no simulations) from a network of laboratories in addition to conventional Learning Management Systems
- Two Italian Universities funded by Italian Ministry of University Education and Research in 2003, completed by 2005
- Exploitation involved 16 more Italian Universities and the University of Zagreb
- Endorsed by the Italian Society of Electric and Electronic Measurement (GMEE) and named after the founder of the Scientific Sector in Italy

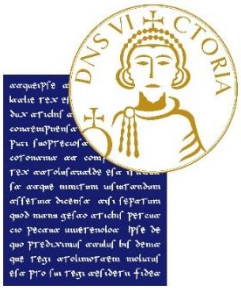


RESEARCH OBJECTIVES: LAB ACTIVITIES



- Remote execution of the experiments by the teacher (level 0)
 - The students can observe how the teacher manages the instrumentation (reached)
- Remote visualization of experiments (level 1)
 - The students launch an automatic VI and view the results (reached)
- Remote control of experiments (level 2)
 - The students manage the VIs and view the results (reached)
- Remote design of VIs (level 3)
 - The students can design a custom VI using remotely the LabVIEW environment (not reached)

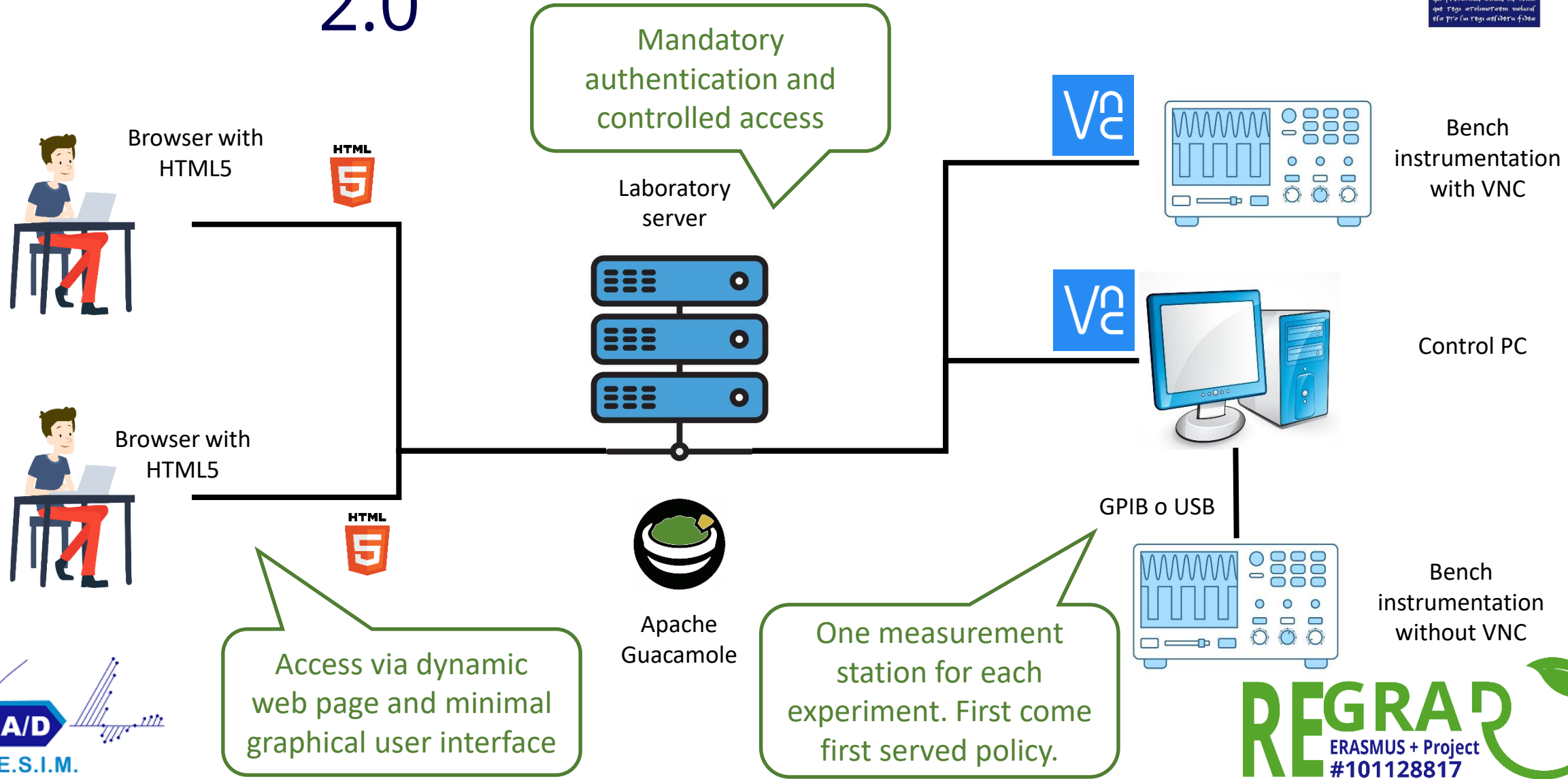
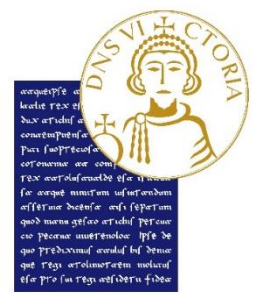
NEW OBJECTIVES AND CONSTRAINTS



- Given the strategy of University and the enrollment reduction over the following 15 years, the remote lab was mainly used to recover missed lab classes.
- New targets in 2020:
 - to renew the software technologies to improve flexibility,
 - to improve graphic quality,
 - to allow applications to be developed on remotely accessible PCs under teacher's supervision.
- Two weeks to upgrade LA.DI.RE. software technologies while preserving LMS functionality and maintaining teaching schedules.
- One month deadline to start the students' project development activities.

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ARCHITECTURE OF REMOTE LAB 2.0



Mandatory authentication and controlled access

Laboratory server

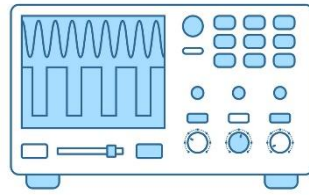
Browser with HTML5



Browser with HTML5



Apache Guacamole

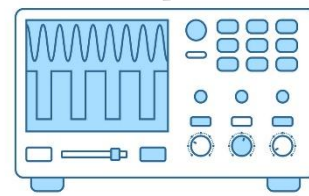


Bench instrumentation with VNC



Control PC

GPIB o USB



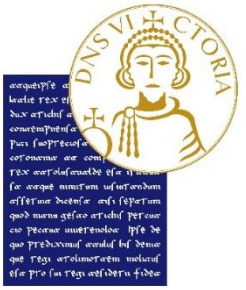
Bench instrumentation without VNC

One measurement station for each experiment. First come first served policy.

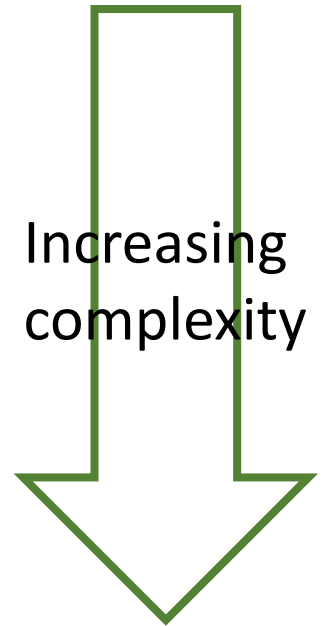
Access via dynamic web page and minimal graphical user interface



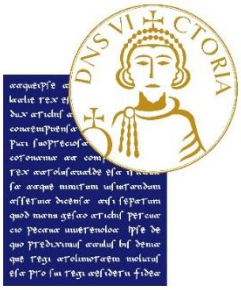
LABORATORY ACTIVITIES



- Independent experiment (Level 1) with automatic execution
- Independent experiment (Level 2) with manual execution
- Guided experiment (Level 0)
- Autonomous development of applications and group projects (Level 3)



LEVEL 1 EXPERIMENT WITH AUTOMATIC EXECUTION

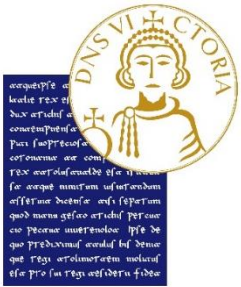


- Minimal graphical user interface developed for instrument control
- Webcam display of instruments during execution
- File transfer of readings via the web
- Results processing and report writing offline
- 6 experiments developed for two introductory subjects
- Involved students: 65



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LEVEL 1 EXPERIMENT: DOCUMENTATION



VIDEO - LEZIONE



Task
description

ESERCITAZIONE #3

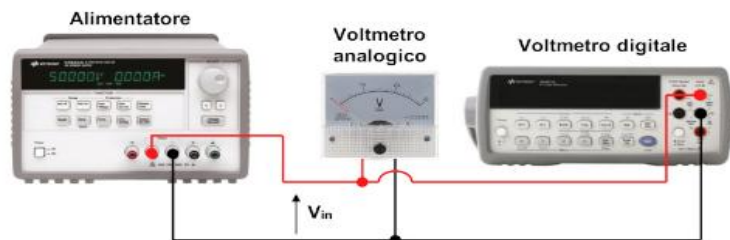


CARATTERIZZAZIONE METROLOGICA DI UN VOLTMETRO ANALOGICO

Scopo dell'esercitazione è quello di effettuare la caratterizzazione metrologica di un voltmetro analogico rispetto ad un voltmetro digitale, andando ad eseguire i seguenti test statistici: il test Z, il test t di Student, il test del X^2 e il test delle medie. Al seguente link [\[LINK\]](#) è disponibile una guida per la stesura della relazione.

Instrument
connections

SETUP DI MISURA



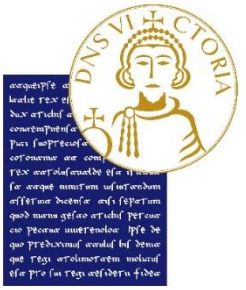
STRUMENTAZIONE UTILIZZATA

- Alimentatore: **Agilent E3634A** [\[Manuale .PDF\]](#)
- Voltmetro digitale: **Agilent 34401A** [\[Manuale .PDF\]](#)
- Voltmetro analogico: **Nimex CMU-38, classe 2.5**

Video-
recorded
experiment

Instrument details

LEVEL 2 EXPERIMENT WITH MANUAL EXECUTION

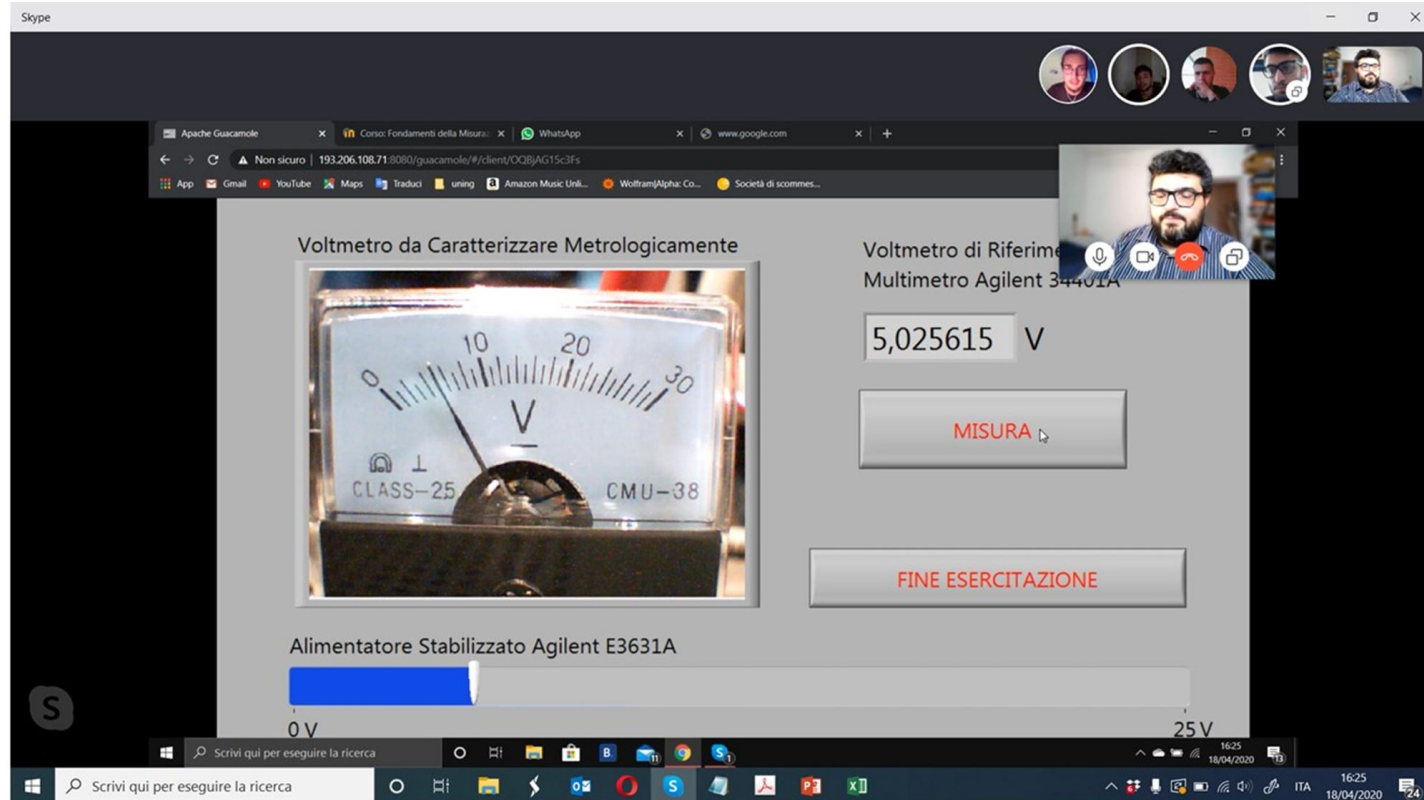
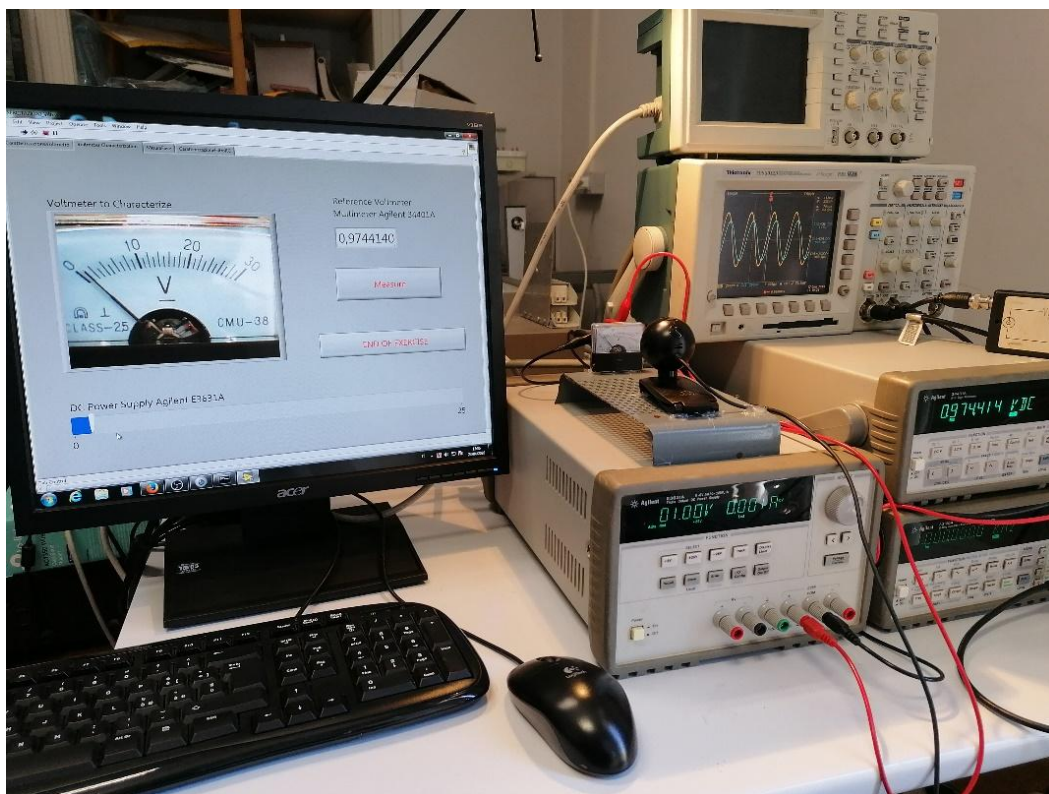
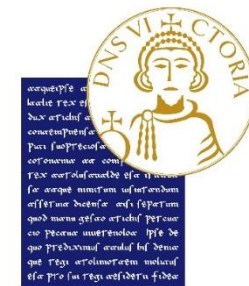


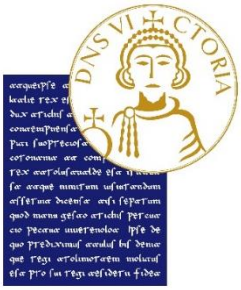
- Direct control of the interface by students
- Thin client user interface to access a LabVIEW VI
- Webcam display of instruments during execution
- No data transfer: readings must be transcribed by hand
- Results processing and report writing offline
- 3 experiments developed for one introductory subject and one advanced subject
- Involved students: 48



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LEVEL 2 EXPERIMENT: TEACHER'S INTRODUCTION

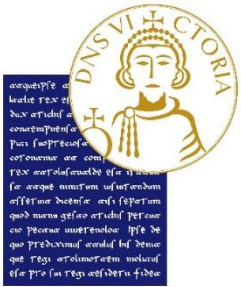




LEVEL 0 GUIDED EXPERIMENT

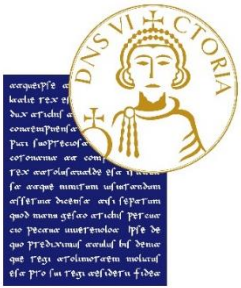
- Direct control of the interface by the teacher while students observe
- Direct control of the interface by students while the teacher supervises
- Web application of the instrument manufacturer or complete desktop control via thin client user interface
- No display of instruments during execution
- No data transfer: readings must be transcribed by hand
- Results processing and report writing offline
- 4 experiments developed for one advanced subject
- Involved students: 17

LEVEL 0 GUIDED EXPERIMENT: EXAMPLE



Time domain reflectometry on coaxial cable

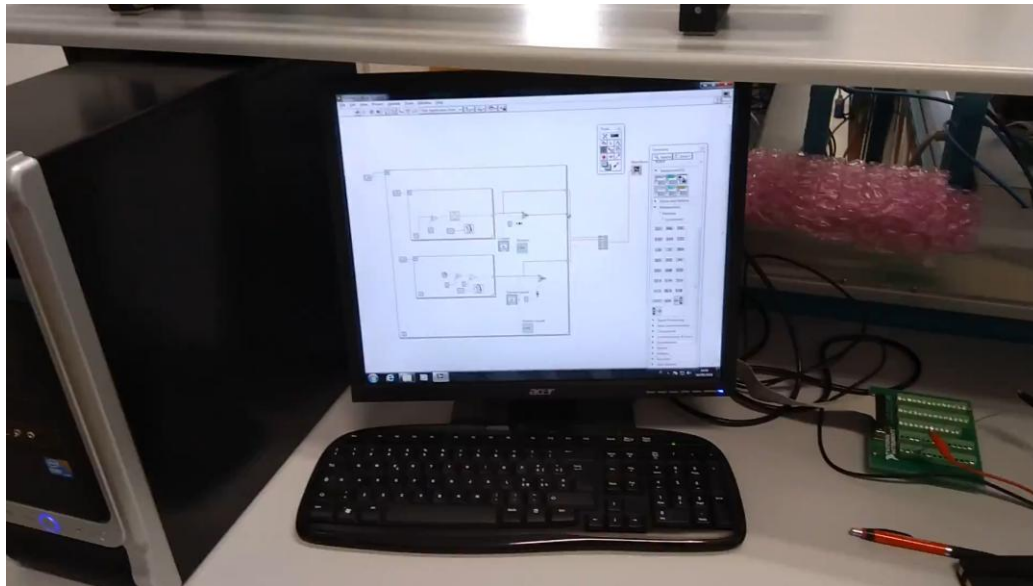
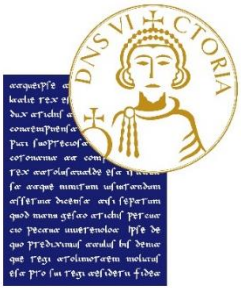
LEVEL 3 PROJECT DEVELOPMENT



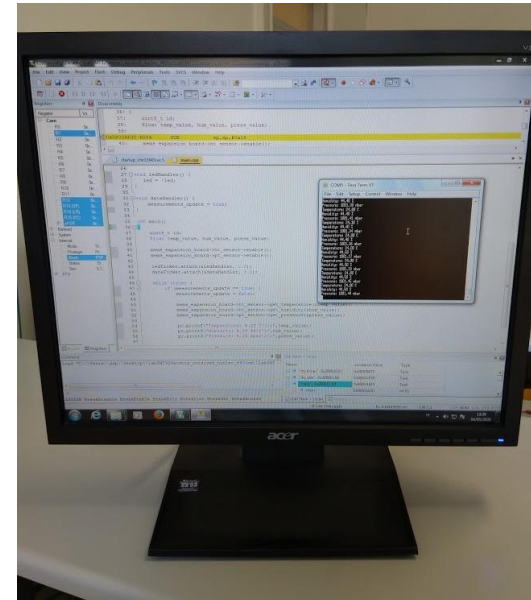
- Development of software applications to realize measurement systems based on data acquisition boards, programmable instrumentation, or microcontrollers
- Circuit and connections made by Faculty staff
- Remote desktop control
- No display of instruments during execution
- Simultaneous access to the development environment on one PC by multiple students and the teacher
- 8 remote access-enabled PCs for software application development
- 4 measurement stations enabled for virtual instrument development in LabVIEW
- Students involved in total: 23

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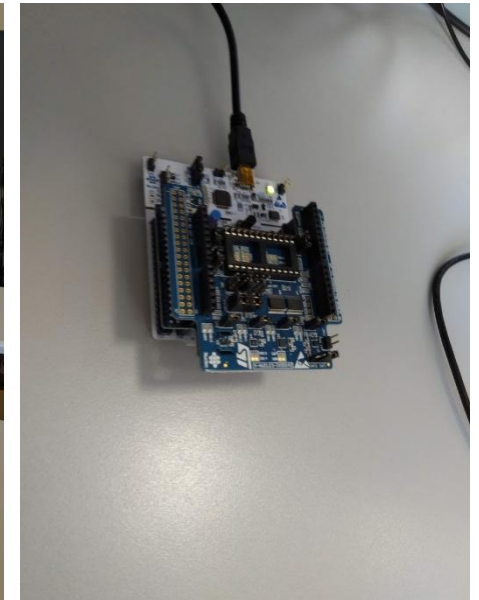
PROJECT DEVELOPMENT: IN THE LAB



Development of LabView VIs
(Bachelor in Information Engineering and Master
in Electronics Engineering)

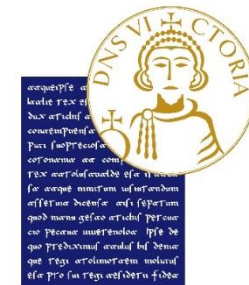


Development of microcontroller-based IoT systems
(Master in Information Engineering)



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PROJECT DEVELOPMENT: SUPERVISOR DESKTOP



The screenshot displays a web interface for managing remote desktop sessions. At the top, a browser window shows the URL `lab-po.ding.unisannio.it:8080/guacamole/#/`. Below the browser, a grid of six thumbnails represents active sessions, labeled BANCO_03, BANCO_06, BANCO_09, BANCO_08, BANCO_07, and BANCO_04. Each thumbnail shows a different desktop environment, including spreadsheets, code editors, and desktop icons. Below the grid, a section titled "TUTTE LE CONNESSIONI" (All Connections) contains a list of sessions from BANCO_01 to BANCO_09. To the right of this list, there are status indicators for each session, such as "Ora utilizzato da 2 users." and "Ora utilizzato da 1 user."

Ora utilizzato da 2 users.

Ora utilizzato da 1 user.

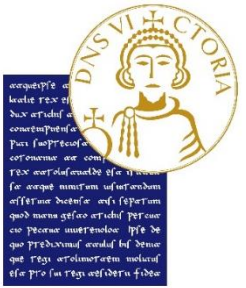
Ora utilizzato da 2 users.

Ora utilizzato da 1 user.

Ora utilizzato da 2 users.

Ora utilizzato da 2 users.

CONCLUSIONS



- The COVID-19 pandemic forced us to significantly revise our educational offerings in terms of laboratory exercises.
- The results observed on a small number of students were encouraging and let us to overcome the strict limitations imposed by anti-COVID-19 laws without stopping the teaching activity
- We have improved the LA.DI.RE. in terms of full control of remote stations for application development
- The remote experiments cannot fully replace the actual ones for a number of reasons:
 - lack of personal interactions with the teacher and the other students,
 - lack of physical interactions with the instruments and the circuits/devices under test
- However they can be useful in particular contexts. We developed the technology and can deploy it again if necessary. The research continues within the Exendable project.