

LaboRem: open lab for remote work

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Introduction: context

- e-learning, distant work
- web technology, connectivity => labs in network
- to encompass the entire learning process:
 - ◆ lectures, tutorials, simulations, **labs**
- 3 types of labs: hands-on, virtual, remote
- undergraduate education in signal, circuits and systems
 - ◆ more ... (robotics, mechanical engineering)

State of the art: pros and cons of e-labs

■ Pros

- ◆ money: mutualization
- ◆ space: at home, foreign universities
- ◆ time: 24/24, 7/7, repetition, autonomy
- ◆ complementarity of types of 3 labs
- ◆ disabled students, non-affiliated

■ Cons

- ◆ prerequisites, bad preparation
- ◆ not realistic
- ◆ not direct communication, not real-time, async.
- ◆ pedagogical efficiency, evaluation

Objectives

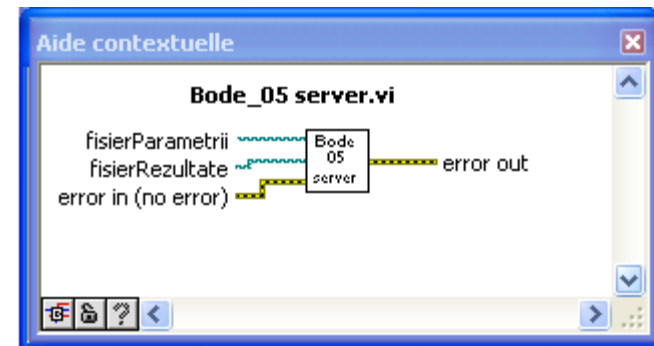
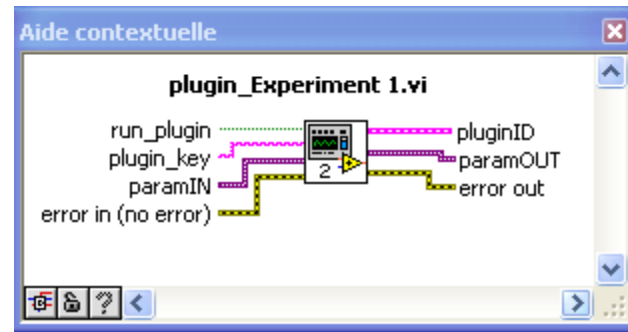
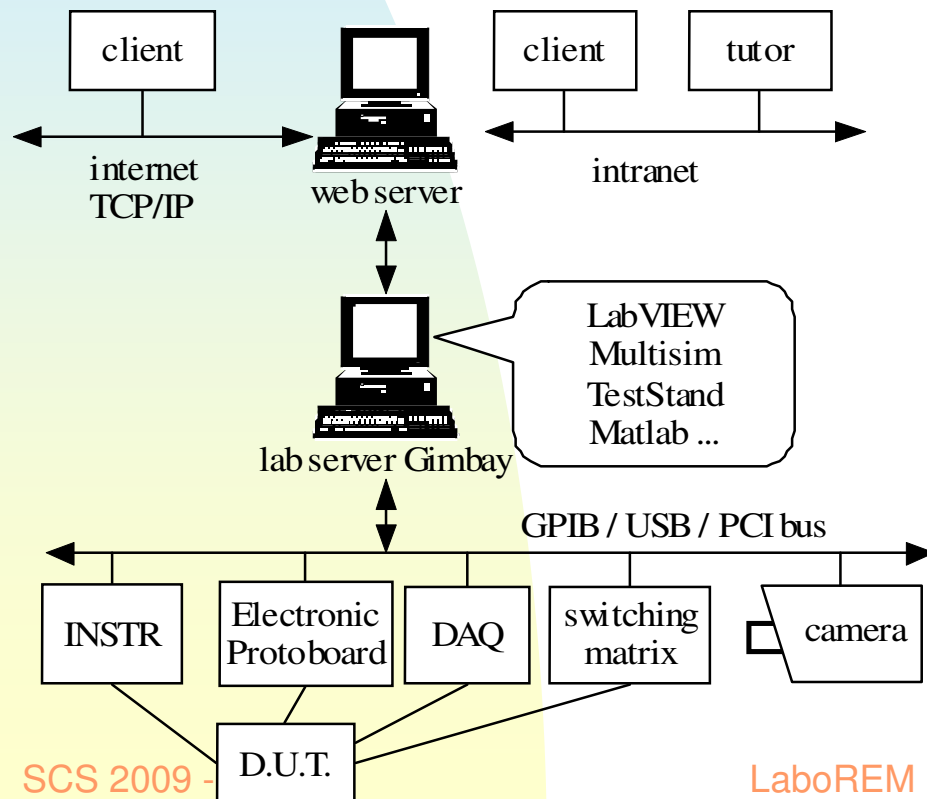
- reduced costs: investment, maintenance
- help tutors to add new experiments
- => extensivity, flexibility
- students at undergraduate level
- international cooperation
- => democracy of technological knowledge

Contribution

- plug-in concept:
 - ◆ templates for connecting easily new experiments (complex VIs)
- game-like approach:
 - ◆ « GBL » game-based learning
- lab sequence design:
 - ◆ student = Device Under Test

Open architecture

- client-server architecture
- 2 servers: web + experiments
- template plug-ins for experiments: client, server



Prototype Implementation

- Implementation: LabVIEW, GPIB, Internet Toolkit lib, TCP/IP
- Hardware:
 - ◆ instruments for T&M (oscilloscope...)
 - ◆ DAQ board, NI-Elvis protoboard
 - ◆ switching matrix
- Software:
 - ◆ Multisim
 - ◆ TestStand

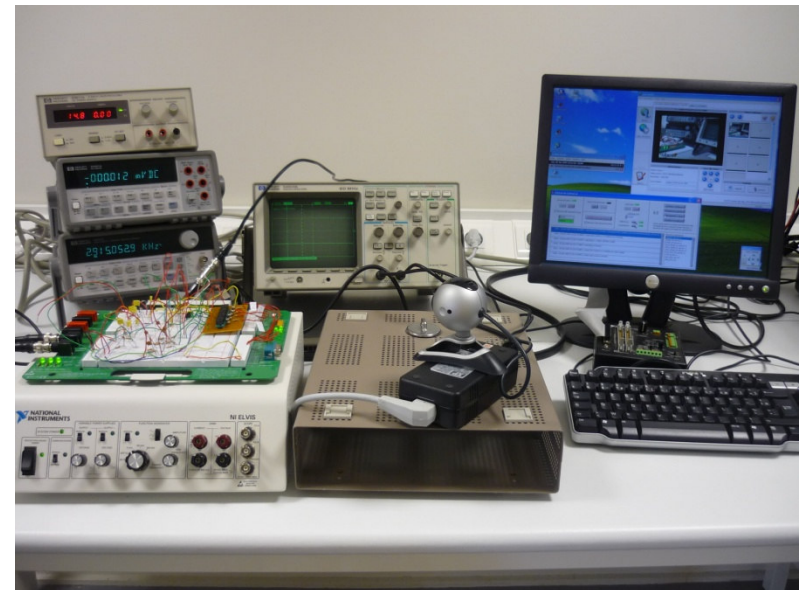
Server side

- Hardware: server and devices
- Software: control center
 - ◆ HMI: management, watchdog

The screenshot displays three windows from the control center software:

- Centrul de Control.vi:** Shows server status (Server de web G, Server Remote Panel, watchdog), a watchdog timer set to 8.5 minutes, and a status indicator for the control center (Running). It includes buttons for Start/STOP and a 'IESIRE Centru de Control' button.
- Management Utilizatori.vi:** A user management window with a list of users (labview1 to labview9), fields for Username (labview26), Parola (labview), and Grupa (Lab). It includes buttons for 'Adauga / Modifica Utilizator', 'Arhiveaza fisier utilizator', and 'Sterge Utilizator'.
- Management Coada.vi:** A queue management window showing a list of experiments in progress. The table below shows the current queue:

Data / Ora	Utilizator	Nume experiment
30-06-2009 14:50:41,59	test	Bode_05
30-06-2009 14:50:57,49	test	Bode_05
30-06-2009 14:51:28,79	labview1	Bode_05
30-06-2009 14:53:27,31	labview2	Bode_05
30-06-2009 14:53:57,28	labview7	Bode_05

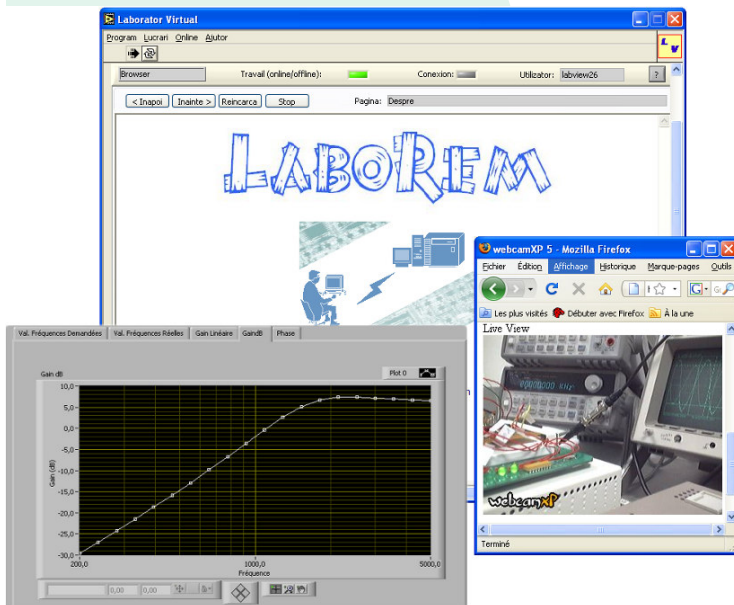


Client side



A login form on a grid background. It includes fields for 'Username:' and 'Password:', a 'Login' button, an 'Offline' button, and an 'EXIT' button. The text 'LV 8.5' is visible on the right side of the form.

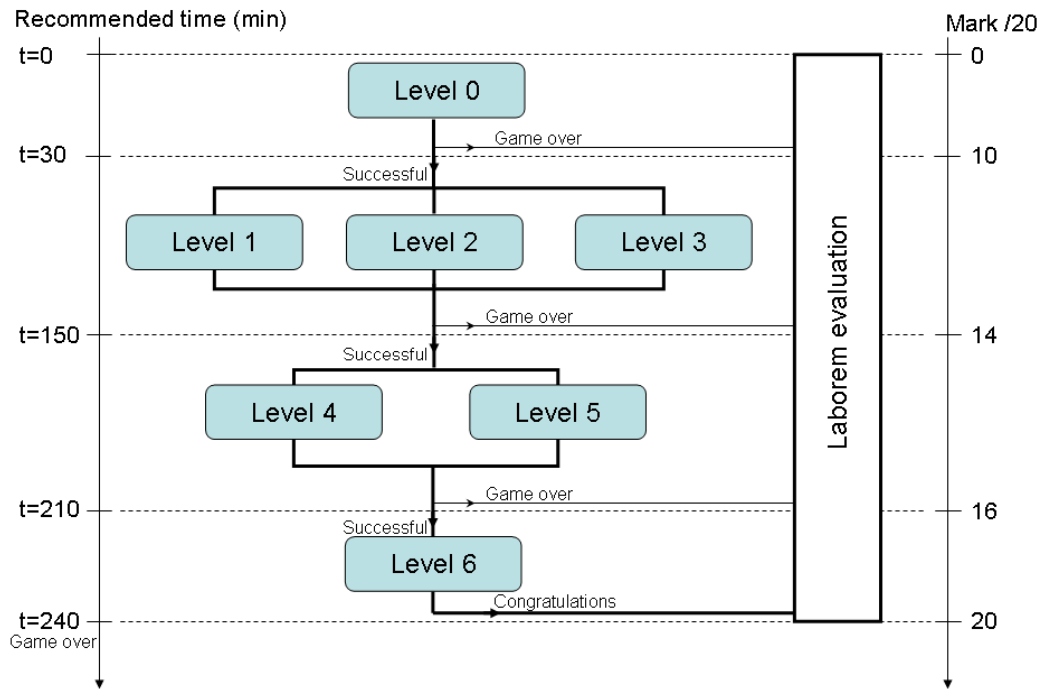
- HMI (after login through web)
- upload of parameter settings
- download of data results
- video feed-back (webcam)
- fill-in questionnaires



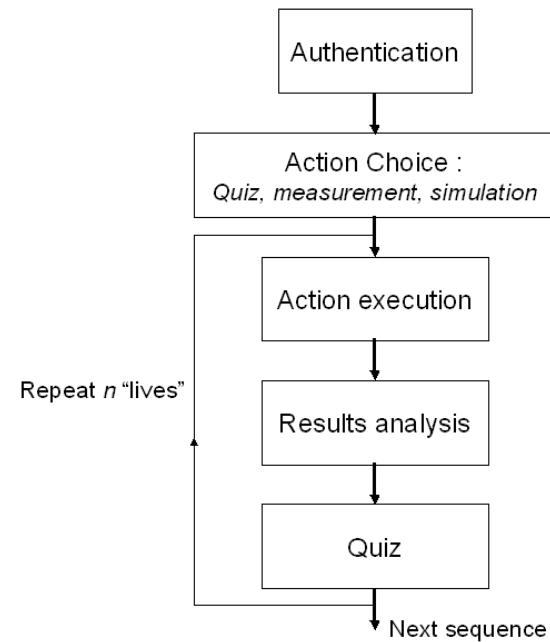
SCS 2009 - Djerba

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Lab sequence design

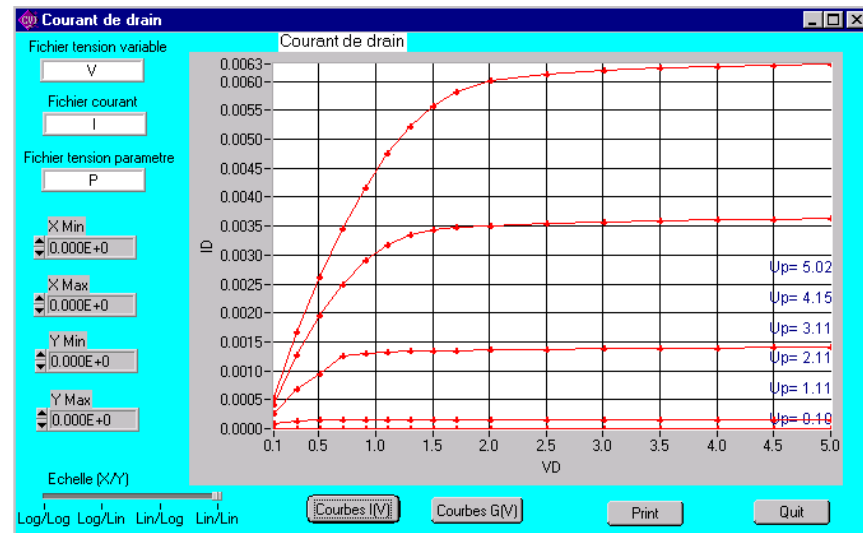
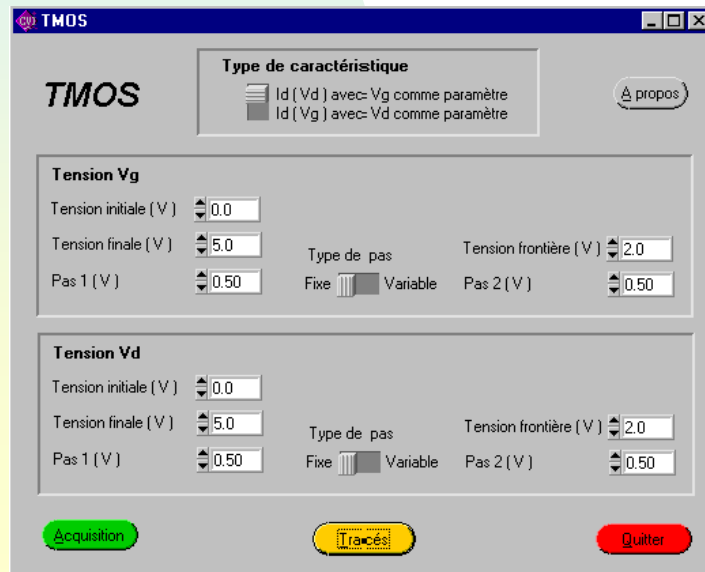
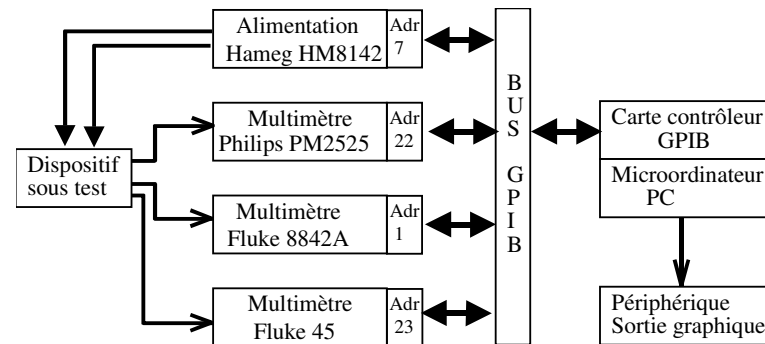
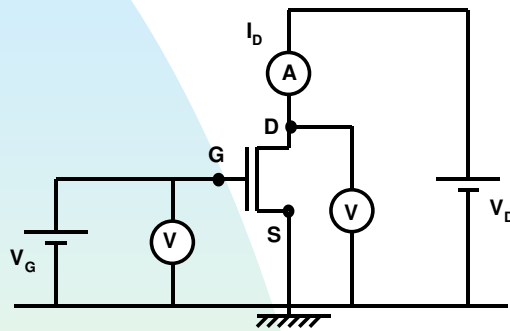


- levels (difficulty)
- lives (repetitions)
- limited time
- scores (mark /20)

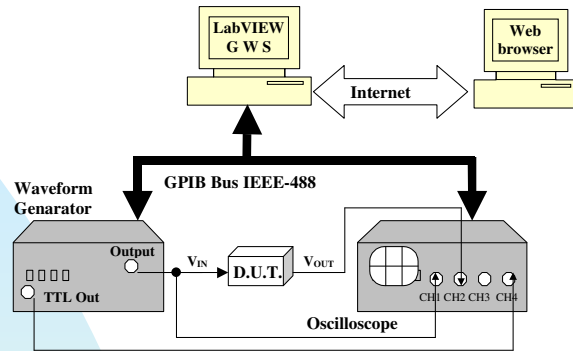


Example 1: circuit testing

- characterization of MOS transistors
 - ◆ for research activity (but also teaching)



Example 2: student activities



- remote control of measurement devices
 - ◆ Bode plots of active filters
- quiz: game over
- simulation:
 - ◆ Multisim (circuit design)
 - ◆ Matlab (signal processing)
- hands-on: compare



Statistical Evaluation

Exemple of questions					
I liked to do labwork from anywhere and anytime	1	2	3	4	5
I liked to control remotely real instruments	1	2	3	4	5
I was motivated by the game-like lab sequence	1	2	3	4	5
I need more preparation to LaboREM	1	2	3	4	5
I need a remote control of the camera	1	2	3	4	5

(1=strongly agree, 2=agree, 3=neutral, 4=disagree, 5=strongly disagree)

Evaluated issue	Mean	Std.dev	Assessment
Technical quality of platform	2.9	2.67	±
Preparation, Docs & Prerequisites	3	2.67	±
Interest of game concept	2.3	2.16	+
Quality of interaction with HMI	2.3	1.96	+
Interest for remote control of devices	2.2	3.57	+
Release from space-time constraints	1.9	2.9	++

Evaluation results

- technical:
 - ◆ 30 simultaneous connections
 - ◆ HMI: richness of media not critical
- pedagogical
- questionnaire: 5-point Likert scale
 - ◆ + anywhere, anytime, repeat
 - ◆ + game-like, camera, remote control
 - ◆ - more preparation
 - ◆ - more collaborative work

Future works

- integration into an LMS (like Moodle)
- web technology : VPN instead of reverse proxy
- collaborative work:
 - ◆ rich media, chat, audio, synchronous communication
- remote control of motorized camera
- mechanical applications (vibration analysis, robotics, image processing etc.)
- open to collaboration with foreign countries...