

Background

Developing a remote lab involves many **issues**:

- **Sociology**: game-based and adaptive learning are good solutions to enhance students' motivation,
- **Democracy**: national and international cooperation between technological universities,
- **Economy/Ecology**: Mutualization of expensive equipment.

Objectives

Objectives and needs for LaboREM:

- Learn to work in a new way by doing **remote activities** (SCADA),
- Make the application fun and adaptive to **increase student motivation**,
- Accessible **via the network** (WAN or LAN).

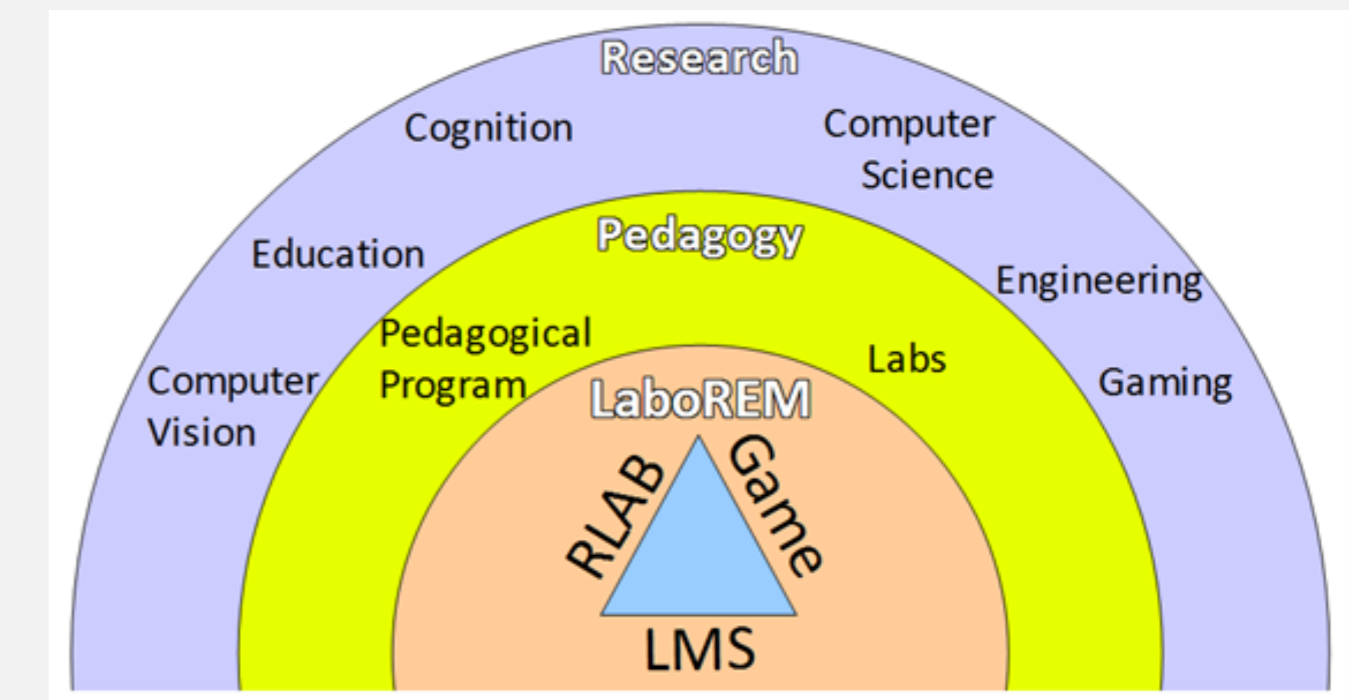
Synopsis

LaboREM (for remote laboratory) mixes three things together:

- a **remote lab**,
- a learning management system (**LMS**),
- a **game-like approach**.

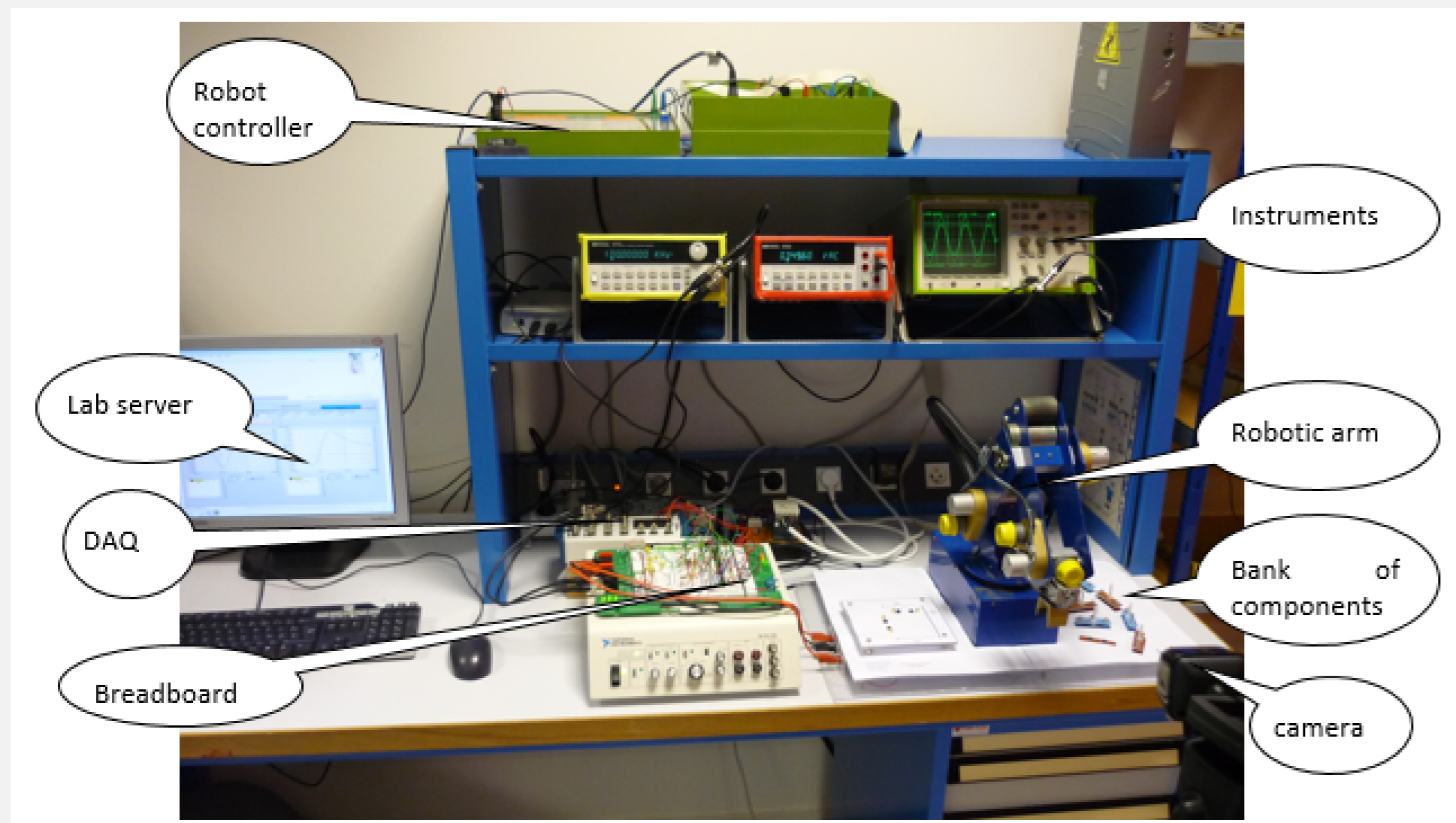
LaboREM provides mixed pedagogy that includes hands-on, simulations and remote labwork (blended learning).

LaboREM project

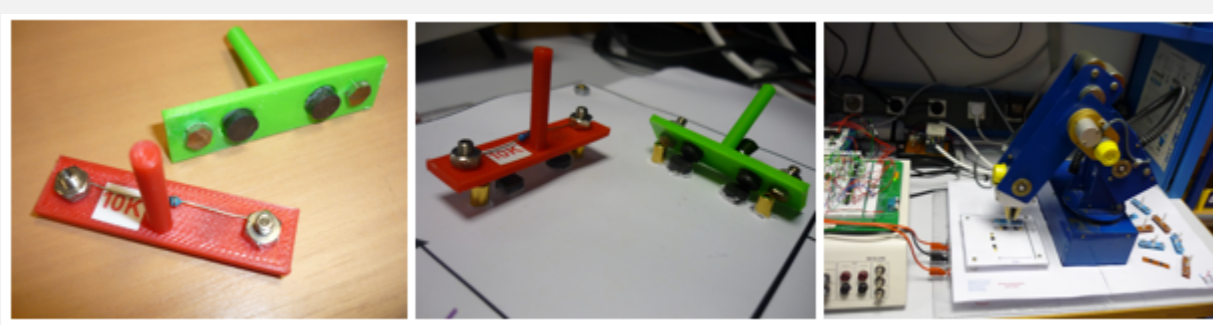


Remote lab (with robot and camera)

Remote lab overview :



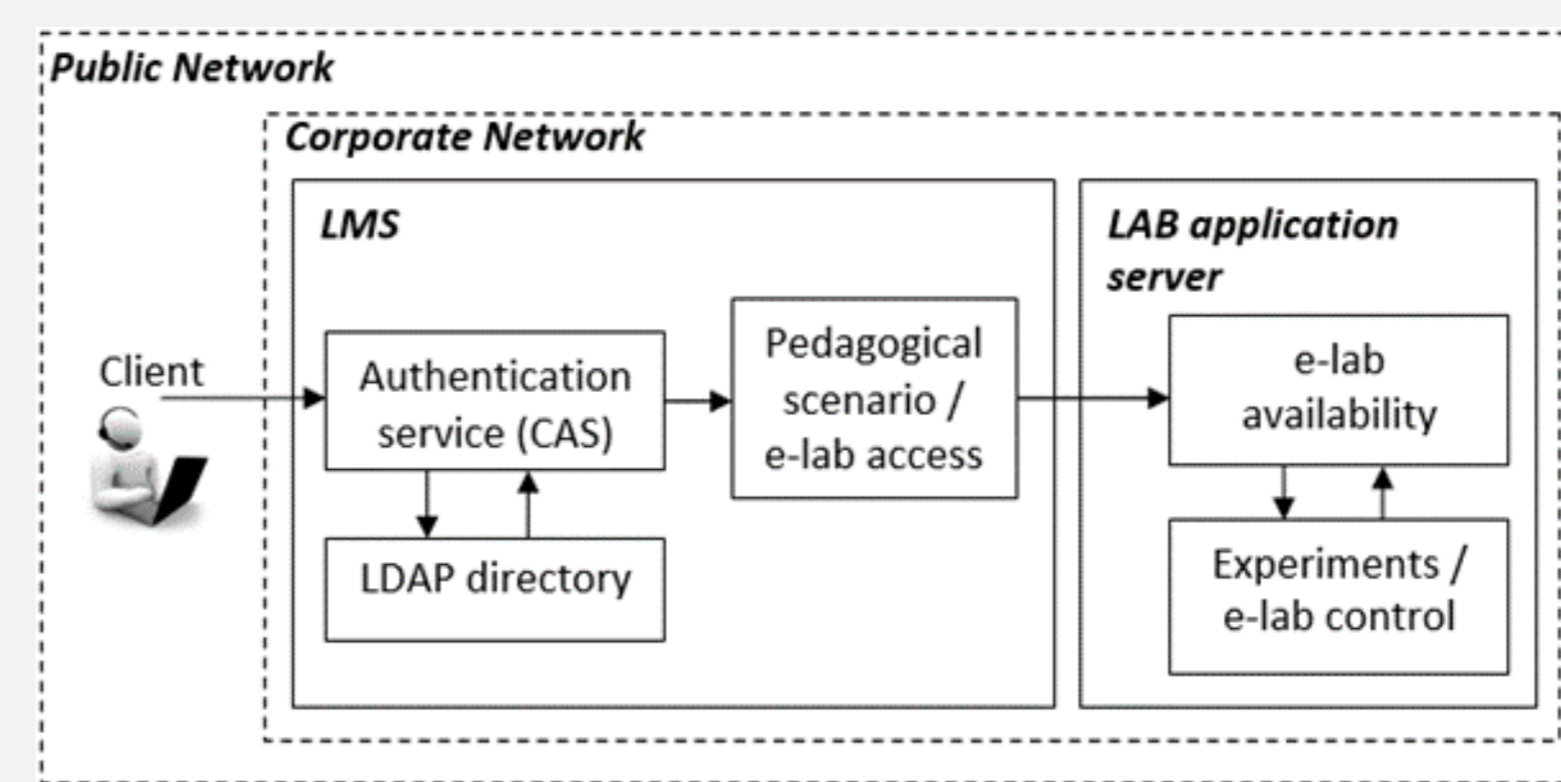
Components equipped with magnets :



Implementation

Implemented for e-learning in electronics : LaboREM prototype deals with operational amplifiers (OA), active filters and oscillators.

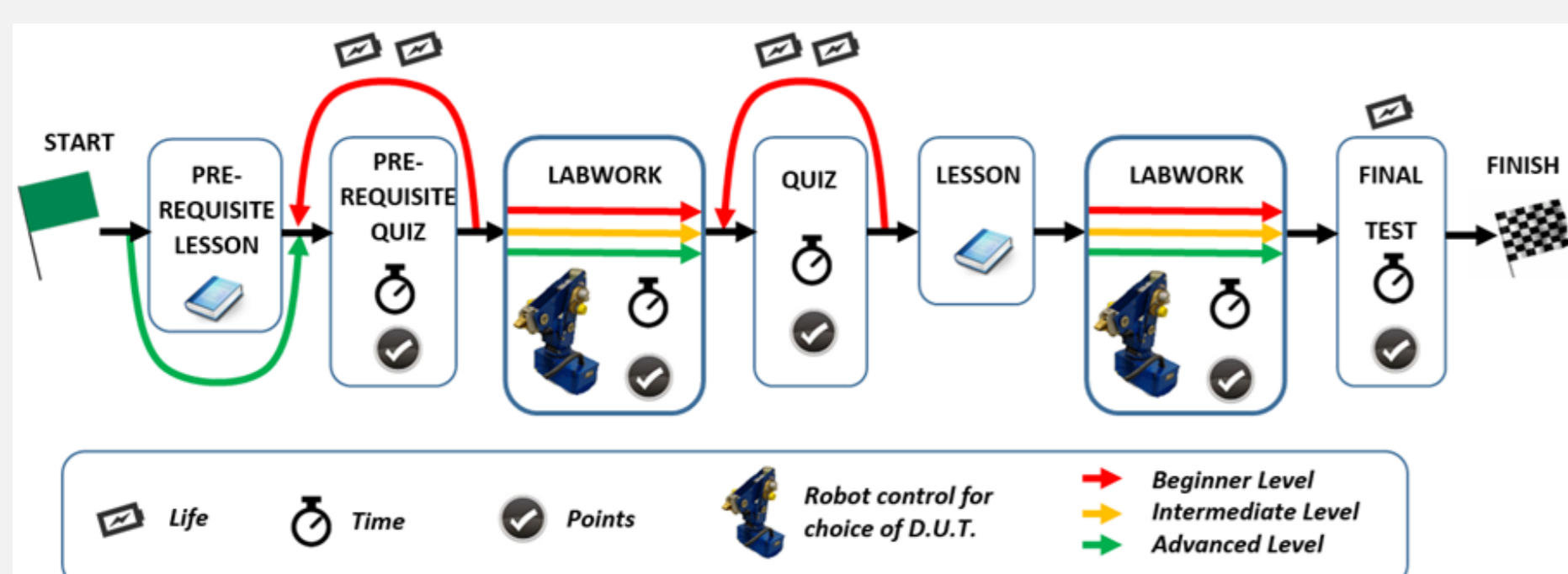
- Virtual instruments (VI) are designed for the management of remote experimentation. These VIs can be accessed, through the web, via a learning management system (LMS) used for the supervision of students and for the collaborative work.
- The **client-server architecture** allows remote control of instruments in real-time.



- Feeling of immersion via the use of a **video camera** (with user-specific requests) and a **robotic arm** for placement of components ; this is intended to mimic both the **user eye** and **user hand**.
- The hardware setup consists of various instruments (waveform generator, multimeter, oscilloscope), plus other equipments (data acquisition, electronic protoboard, switching matrix with relays, robotic arm, camera) that are connected to the labserver.

Pedagogical scenario (Game like strategy & LMS)

- **Game like approach** : *mystery* (unknown filter to uncover), *sensory stimuli* (visual feedback and robotic motion), *challenge* (Top 10), *control* (choice of DUT), *rules* (limited time and number of trials), *clear goals* (learning objectives with three difficulty levels to choose from), *fantasy* (freedom to conceive one's own circuit).

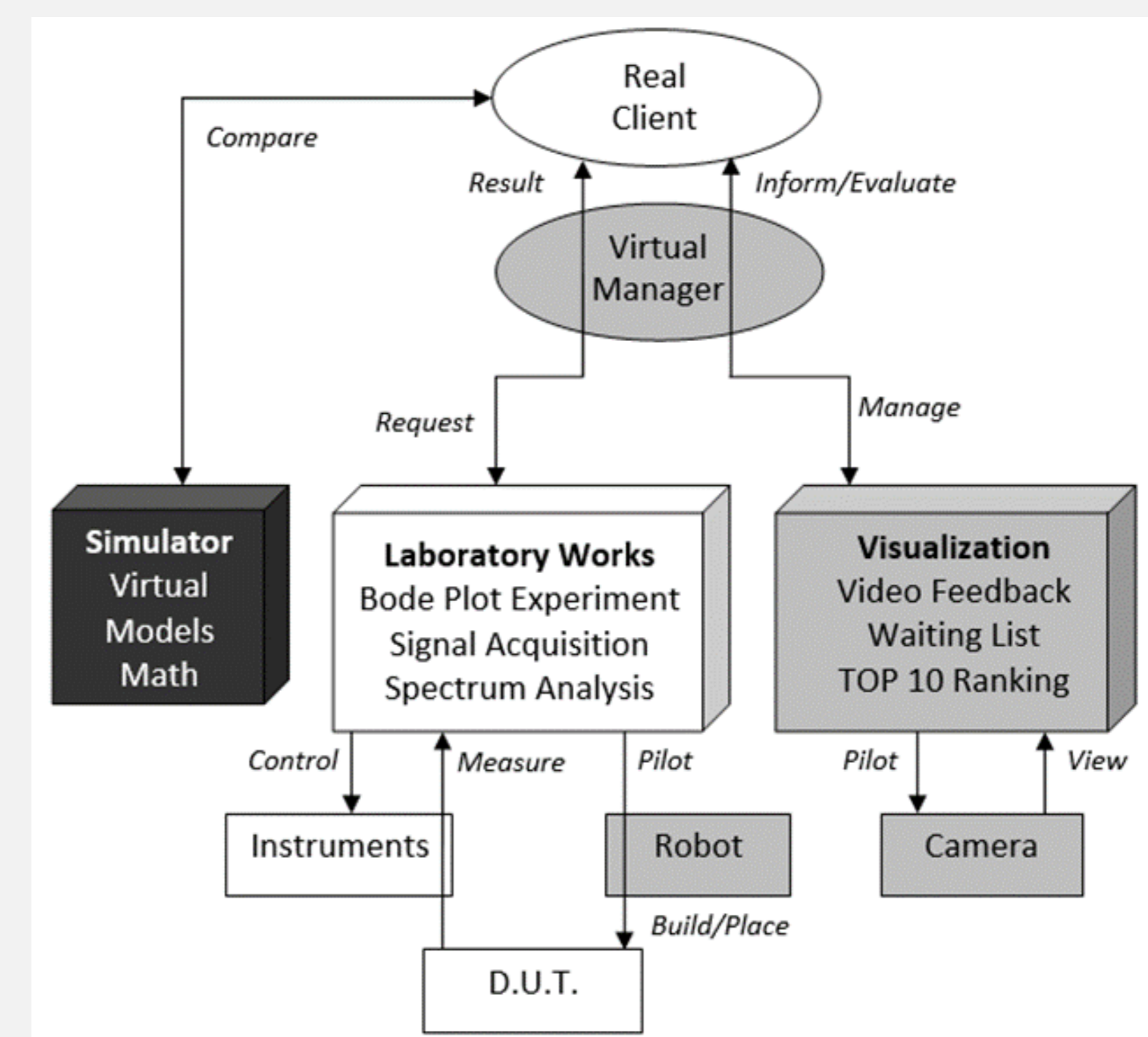


LMS



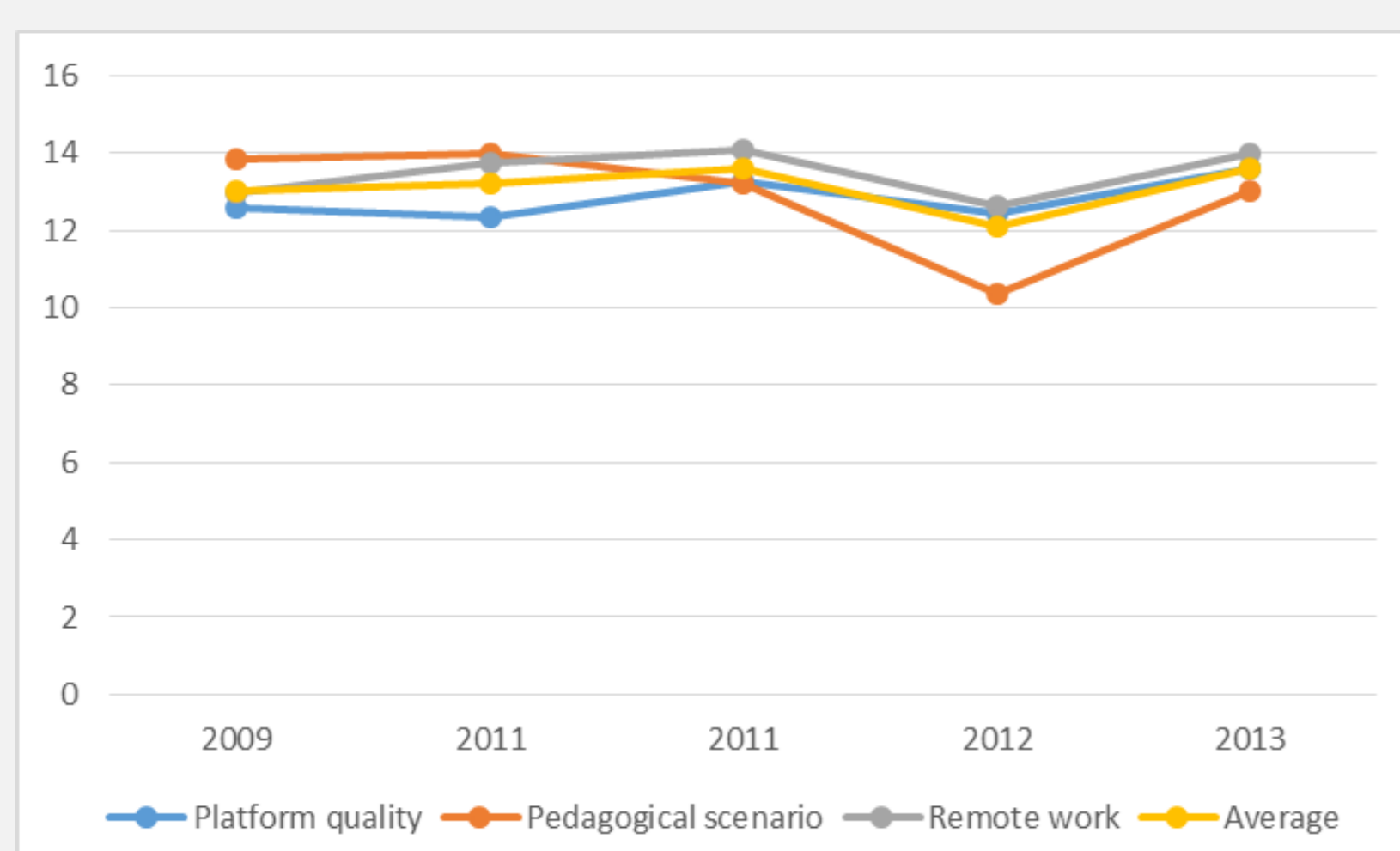
Software application

Blocks in gray depict functions that are added to get a remote lab, starting from a hands-on lab (blocks in white)

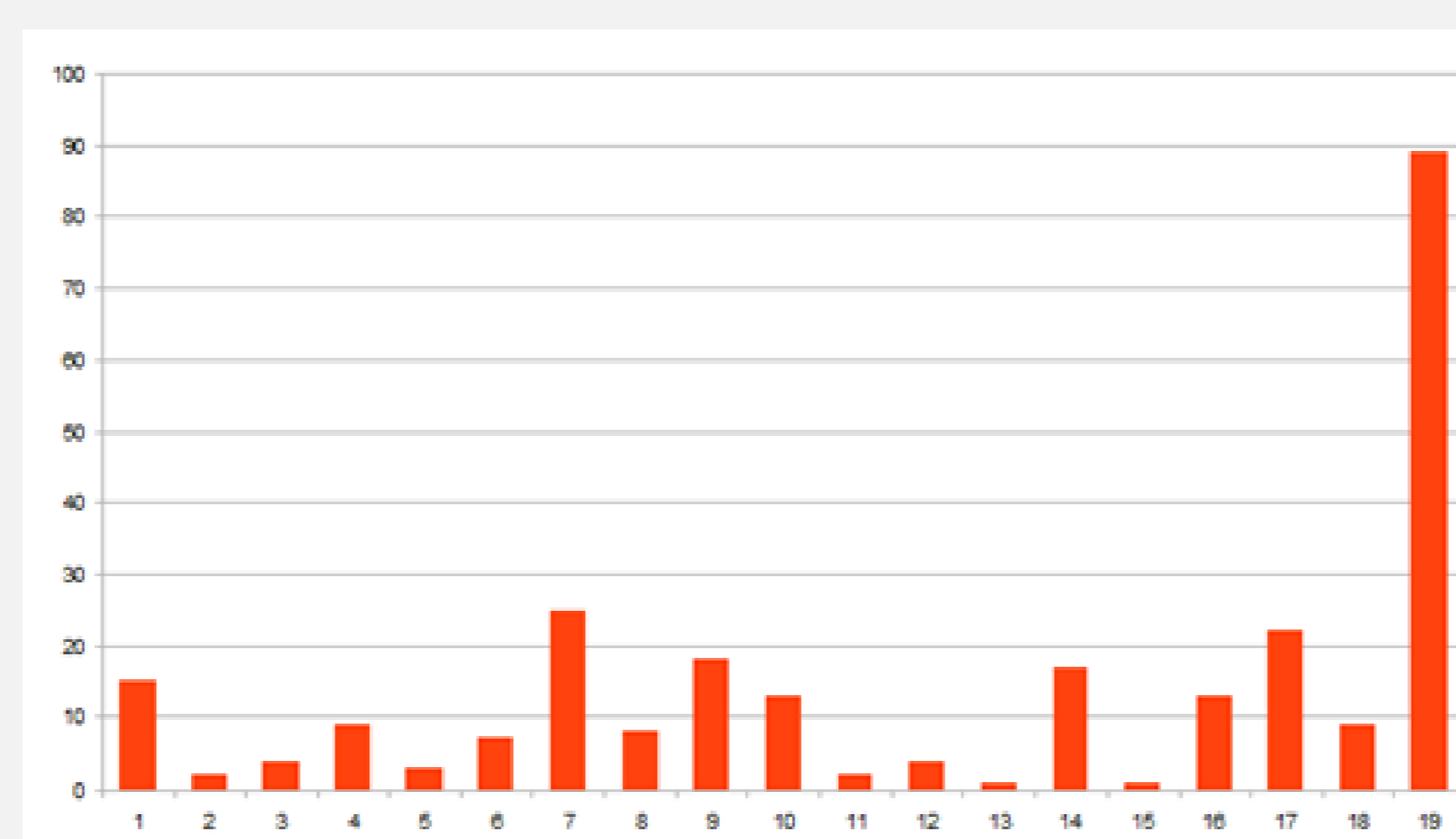


- **LaboratoryWorks**: enables to select the type of experiment (Bode plots or spectrum analyses) and the type of filter built by the robot. It allows to recover data graphs and to participate to Top 10 ranking.
- **Visualization**: gives a feedback of the remote lab (VideoFeedback, Waiting List, TOP10 - "hall of fame").
- **Simulator**: gives an access to a virtual lab (theoric datas).
- **VirtualManager**: in charge of the lab management (Storage, Scheduling, Initialization and Security).

Results

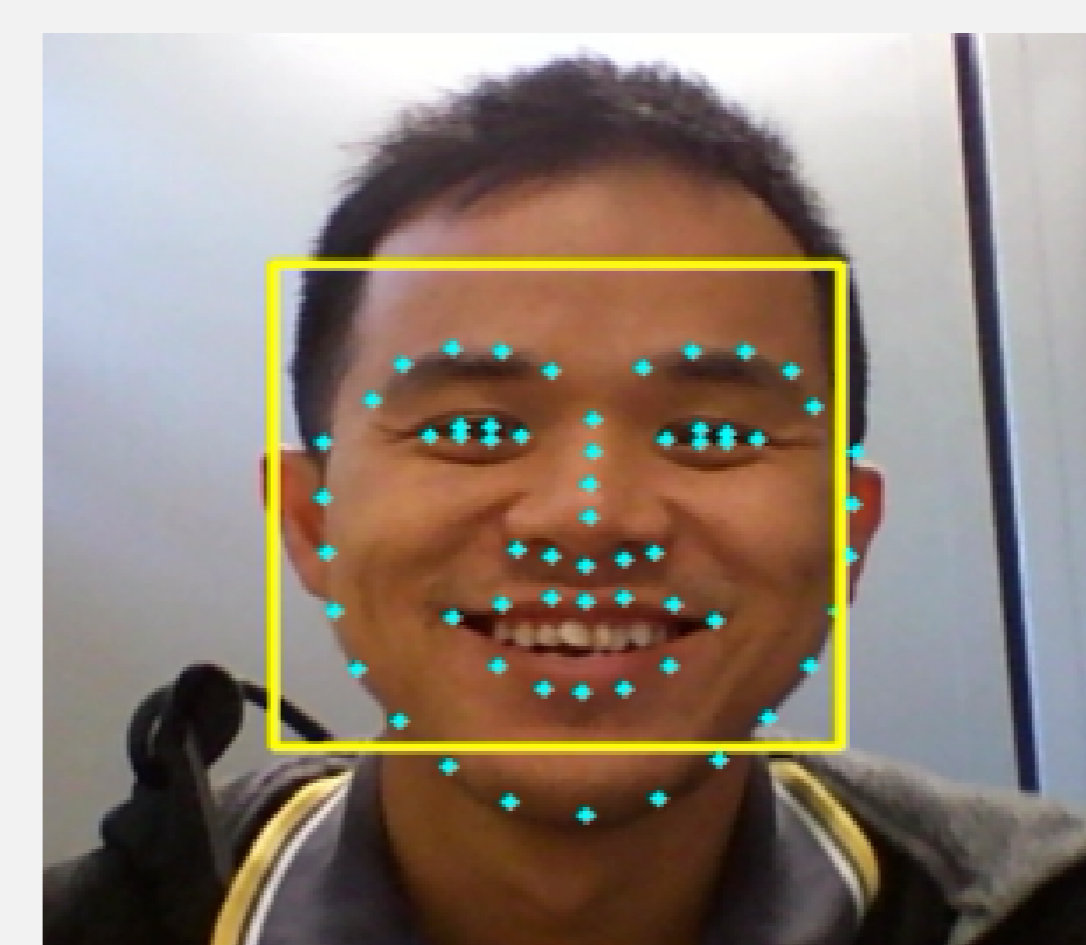


Evaluation survey with students from DUT GIM Bayonne



Number of connections vs. time (before lab deadline)

Image processing for remote lab



Detection of concentration signs and facial expression analysis



Drone for dynamic vision (increase student motivation)