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WEB-BASED OSCILLOSCOPE CLONE FOR E-LEARNING

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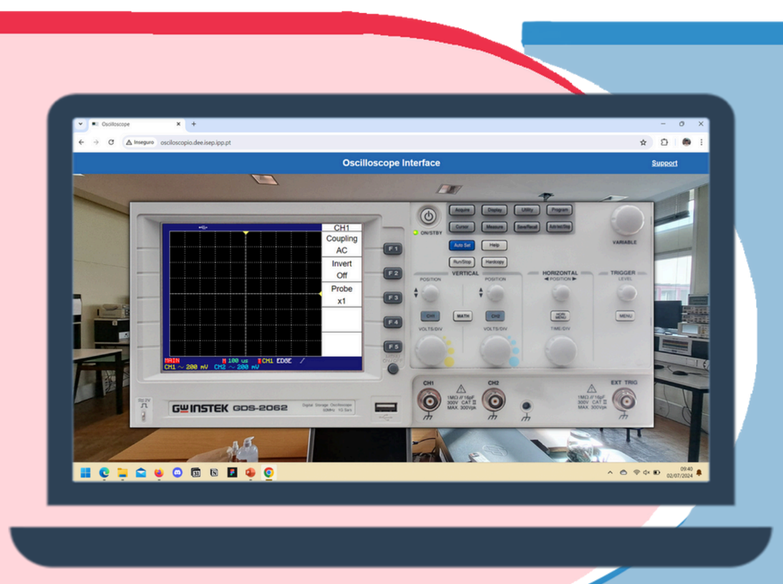
CONTEXTUALIZATION

The last three co-authors of this paper have been developing innovative teaching tools for DC/AC circuit courses like TCIRC, which is part of the 1st-year Electrical and Computer Engineering degree at ISEP.[1][2][3] Their efforts include Oscilloscope simulators, which have been helpful for students and teachers. Earlier versions of this tool have been used for almost two decades.[4][5] This new web-based version expands its reach and offers improved robustness and functionality.[6]

CONTRIBUTIONS

Our main contribution is the design and development of an Oscilloscope Interface app with two modes: Simulation and Acquisition & Control. The app replicates the lab equipment in both interface and functionality. It is freely available to the international community, along with its source code. The Simulation mode has been used by TCIRC teachers and students for lectures, preparing Lab Script 2, and the first lab test. A user experience questionnaire received constructive and mostly positive feedback from nearly two hundred students.



OPERATING MODES

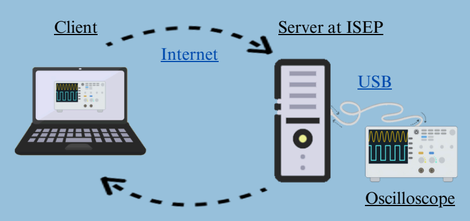
The Oscilloscope Interface web app supports two distinct operation modes, each catering to different educational and practical needs:

Simulation Mode

This mode emulates the oscilloscope and signal generator, allowing users to simulate various signals from a CSV file or a virtual signal generator and analyze them using the oscilloscope interface.

Acquisition & Control Mode

In this mode, the web app connects to the real oscilloscope located in the lab of circuit signals at ISEP via a server, enabling users to remotely control the oscilloscope and acquire real-time data.



Lab Script 2 Preparation

TCIRC students used the Oscilloscope Simulator to prepare for Lab Script 2, working in pairs to complete circuit setups and measurements, with most of 226 students finding it helpful.

First Lab Test

Over 230 students used the Oscilloscope Simulator during the first lab test, conducted in shifts of nine, which highlighted the need for a balanced client-server structure.

USER EXPERIENCE

We evaluated the Oscilloscope Simulator app with an online questionnaire among TCIRC students. The questionnaire covered sample details such as age, gender, course enrollment, and worker-student status. It also addressed app usage, user experience via Likert scale questions, and open feedback on positive and negative aspects.

Out of 248 students, 195 (78.6%) responded. Most were 21 or younger (79.0%), male (87.7%), and first-time course enrollees (76.4%). The majority (91.9%) used the simulator, finding it easy and enjoyable (83.9%). It helped them understand oscilloscope commands (81.0%), the signal generator (77.1%), and prepare for Lab Script 2 (84.9%).

Positive feedback highlighted access to home equipment, intuitive usability, and realism akin to lab settings. Negative feedback included the lack of an instruction guide, disabled functions/buttons, and difficulties with adjusting knobs.

CONCLUSIONS

In conclusion, we developed a robust, realistic, and accessible Oscilloscope Interface web app, available as open-source software. Positive student feedback highlights its strengths and areas for improvement. Future work will enhance features and expand its use to other courses and institutions.

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[6] - Ferreira, J. (2023). "Projeto e desenvolvimento de aplicação web para simulação e interface de Osciloscópio," Master's thesis, Instituto Superior de Engenharia do Porto, Porto.

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