

A Tool to Teach Remote Engineering Laboratories

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Abstract—Students who are currently enrolled in Electrical Engineering Laboratories at the University of North Dakota (or at most ABET engineering institutions) need to perform simulation of various Electrical Engineering circuitry experiments in the form of pre-labs using Multisim and Ultiboard (Electronics workbench) in a B.S.E.E undergraduate curriculum. Currently, we do not have any easy mechanism for distance students (or campus students) to learn this tool, although students have access to text based tutorial handout. It would make a huge impact on student learning, if there is a step by step video tutorial made available to students, keeping in mind that the current generation of students is on YouTube based learning environment. Hence I propose Jing based screenshot tutorials to understand how to simulate circuitry experiments and design a printed circuit board using Electronics workbench software. The feedback from students show that they benefit more through video based learning especially for simulation tools in our Distance Engineering Degree program (DEDP) program environment. It is important to note that University of North Dakota is the only ABET accredited engineering institution in the US offering Distance Engineering Degree program for Undergraduates (B.S.E.E, B.S.M.E, B.S.ChE).

Index Terms - Student learning, Tutorial Screenshots, Jing

I. INTRODUCTION AND RATIONALE

There is a growing need and request from students to have effective tutorials on Circuit Simulation tools such as an Electronics work bench. As part of their BSEE degree program, students are required to perform various pre-labs and laboratory experiments

using the Electronics workbench simulation tool first, before they begin working on their prototype development on breadboard. Currently students use a text based tutorial handout to understand the simulation tool, with no video tutorials available. By developing a video based tutorial on Multisim and Ultiboard, students will have a good grasp on various simulation concepts, an easier understanding of the component location and overall how to best simulate circuit experiments and operate under different test conditions. University of North Dakota is the leader and the only institution offering ABET accredited Distance Engineering Degree Program (DEDP) for undergraduates in B.S.E.E, B.S.M.E, B.S.ChE, B.S.C.I by distance in the nation. All EE Students (both campus and distance students) must take these labs, as part of the B.S.E.E degree requirements. As these labs are mandatory labs, it is often offered throughout the calendar year (Spring, Fall, Summer). Typically, the enrollments vary from 25 to 30 students in each of these laboratories. The Printed Circuit Board (PCB) simulation and design skill is fundamental and most important skill for any Electrical Engineering student. In order to better assist our students in promoting their learning, The following figures Fig 1 and Fig 2 shows a Capture Icon and area of interest that should be visible on your screenshot video in Jing [1].

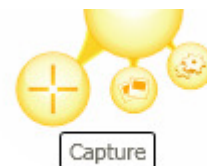


Fig.1 Jing screenshot “Capture” icon

Specific Topics for Video tutorials that are covered using Jing tool are:

- Multisim to Ultiboard Introduction
- Transferred Circuit to Ultiboard
- Ratsnest and Force Vectors
- PCB terms to Know Part 1
- Pads, Vias, PCB, Mils, Silk Screen Layers
- PCB terms to Know Part 2
- Through-Hole, SMT, Netlist, Clearance
- Introduction to Ultiboard Interface
- Adding Text to PCB Layout
- Powering PCB through Header
- Electric Rule Check (ERC)
- Forward and Backward Annotate
- Placing Routes (traces) on Ultiboard

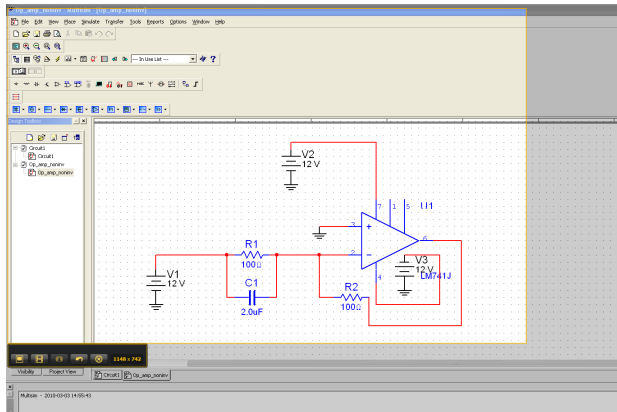


Fig.2 showing selecting Area Screenshot of your desktop with recording buttons

II. INVESTMENT OF TIME FOR INSTRUCTORS

Although, the time investment will depend on the nature of tool that you like to teach, but making a video based tutorial would be helpful and is worth attempting due to its ease of use. Currently students use a text based tutorial handout to understand these tutorials, with no such video tutorials in place at most educational institutions.

III. PEDAGOGY

The proposed Video screenshot tutorials project will benefit student learning highly to better understand the simulation environment and good prototyping in an engineering teaching colleges and universities. This project will also reduce instructor and TA's teaching load slightly and better utilize instructor time on other aspects of student learning process at most universities. The proposed video tutorial project follows a Blooms Taxonomy learning approach and will have impact on all cognitive level (higher and lower) of Blooms taxonomy such as Analyze,

Evaluate, Create, Apply, understand and remember. Fig.3 shows a quick snapshots of Electronics Workbench tutorial using Jing[1][2].

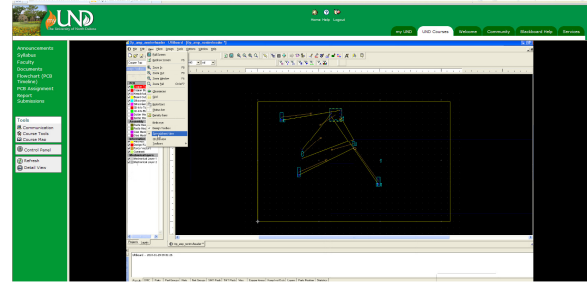


Fig.3: Snapshot of a Tutorial Video 1 using Jing

IV. SUMMARY STEPS IN JING RECORDING

1. Install the Software first from CNET webpage or from www.jingproject.com
2. Go to the center of your screen, click "Capture" icon.
3. Select the area of your desktop screen on how you would like set up your video tutorial.
4. Hit "Capture Video".
5. Record your tutorial or any lecture concept using your headset.
6. Use Stop or Pause Button to control your video.
7. Save the Video "tutorial1.swf". Notice by default the videos are in shockwave format.
8. In order to know how your video turned out, right click on the video and use a web browser to see the captured video. See Fig 4.

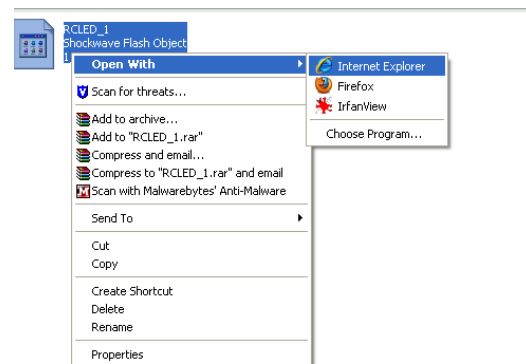


Fig. 4 How to open and view the .swf file

- If your video content is blocked, then allow the blocked content as shown in Fig 5.

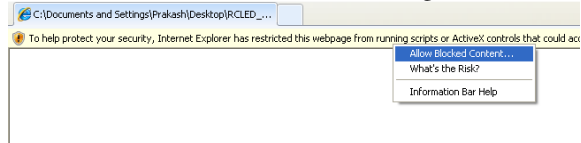


Fig. 5 Allow Access to ActiveX control

- Hit Play button and enjoy your recorded video session.

V. ASSESSMENT OF USING JING IN STUDENT LEARNING

The University Student Assessment of Teaching (USAT) summaries (serving as direct assessment), TABLE I survey conducted and feedback from past student experience reflects the need for such video based tutorials and its learning impact of having video tutorials on laboratories can be easily assessed through direct and indirect assessments (laboratory discussions) from students in each academic calendar in their respective institutions. Fig 6 enumerates the difference concepts of Electronics workbench in Jing based .swf files.

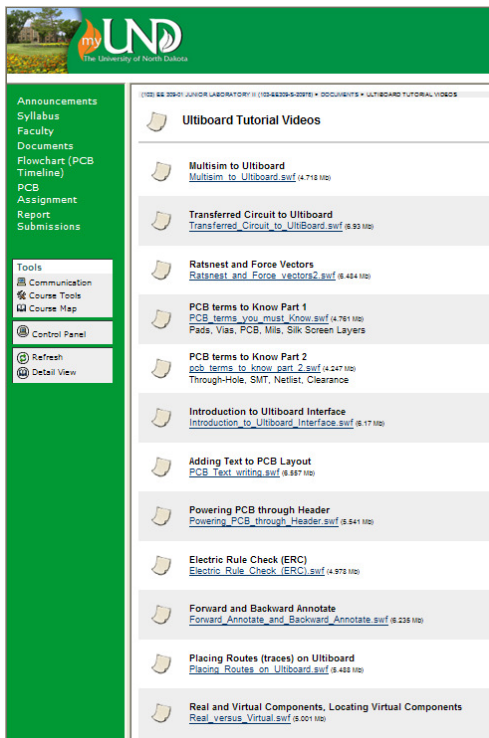


Fig.6 A snapshot of various tutorial concepts in .swf of Ultiboard using Jing on Blackboard

TABLE I. SURVEY RESPONSES FOR EE 309, JUNIOR LAB II, SECTION 1, DURING SPRING 2010 SEMESTER WITH 21 STUDENTS ENROLLED.

Question	Impact on Student learning through student survey Responses, Score range from 1 to 10 with 10 being very effective
1. Has Jing based tutorial helped you in learning PCB design?	21 responses Average Score: 9.2
2. Is it easy to view the video?. For example., Had trouble playing on Internet explorer, Mozilla or other browser?	21 responses Average Score:8.7
3. Did you feel you were comfortable in understanding concepts such as locating component footprint, ERC check etc.,?	21 responses Average Score: 9.5
4. Overall your satisfaction with Jing based lab teaching?	21 responses Average Score:9.8
5. Would you recommend using Jing for other remote labs?	21 responses, Average, Score: 8.3

VI. PROS AND CONS OF JING

Although the free version of Jing Software can be used for quick tutorials of producing such simulation tools, each recording video session cannot exceed more than five minutes with the free version. For any extended Screenshot capture, one has to rely on other purchased software such as Snagit 9 or JingPro. Depending on your usage, it may not be necessary to purchase these video capture applications.

VII. CONCLUSION

A Jing software based step by step interactive video tutorial guide on Electronics workbench (Multisim, Ultiboard) software for students enrolled in Distance engineering degree program (DEDP) EE laboratories is presented. Having a screenshot based tutorial will impact student learning environment far better than having text based tutorial handout as shown through USAT feedback from students and assessment survey conducted in Section V. The concept of using Jing can be easily expanded to any discipline, where some tutorials need to be made. The author has also presented a workshop on using Jing arranged by Center for Instructional learning and Technology at University of North Dakota, Grand Forks in March 2010 and the feedback was very positive in its use from other colleagues within the university.

VIII. ACKNOWLEDGEMENTS

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Note 1: The author has neither association with Jing software nor any monetary benefit in using this tool. The paper was just an inspiration to promote student learning and teaching in distance environment.

Note 2: The condensed version in the form of a short paper is set to appear on 2010 International Conference on Engineering Education (ICEE 2010), July 18-22 2010, Gliwice, Poland.

IX. REFERENCES

1. <http://www.jingproject.com/>
2. www.ni.com

X. AUTHORS

PRAKASH RANGANATHAN is currently a faculty member in the Department of Electrical Engineering at the University of North Dakota, Grand Forks, ND, USA. Ranganathan's research area and teaching interests are in Distance Engineering Education, novel teaching pedagogies/methods, Electric Circuits Smart Grid technologies and Sensor networks. He is an active member of IEEE and ASEE.

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