USING ALTERNATIVE METHODS TO SUPPORT HANDS-ON-LEARNING (LABS)

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7/21-22/2021
Abstract - The need for students to do labs as part of the methods used to teach technology courses has not changed due to the pandemic. However, completing labs at school or in person may not be possible due to safety concerns. New techniques must be developed to support hands-on-learning in a safer more flexible environment. In support of the education of engineering technology students at Ivy Tech Community College in Fort Wayne, IN, three options have been developed and used: remote labs, virtual environment, and kits at home. This presentation will discuss how these options have been developed and lessons learned regarding their use.
Key deliverables:
1.) How to develop remote labs that can be accessed by students anywhere.
2.) How virtual reality can be used to fill the gap for labs.
3.) How to create and offer kits that students can use at home.

Key takeaways:
1.) What computer resources and equipment were used to develop remote labs.
2.) Developing your own virtual reality in Second Life.
3.) How you can work with vendors to design and offer take home kits for students.
Remote Labs
What is a remote lab?

A remote lab allows users to interface to experiments and equipment that are in a remote location. Remote labs are conceptually related to the “Internet of Things” IoT.

Our model for Remote Lab is MECH-NET. They use LabView (software) and cRIO (hardware) to access Wind Tunnels, Engines, and other expensive equipment in a remote lab setting (Mentor Ohio).

Our reasons are
1.) lack of space (1 sq meter per engineering student)
2.) improved learning for students
3.) better use of equipment that is currently under utilized
4.) experimental testbed for future NSF ATE grants related to IoT

1 – 2017 Engineering Program Review for FW and 2018 Engineering Advisory Board Meeting
2 – Improving Learning Outcomes In EE2010I Using NI MYDAQ in an Inverted Lab
3 – Last inventory show we have ~ 175K of equipment from TecQuipment (not being used)
TC1337 – Classroom (original config)

Present State (now past state)
15 laptops
Wireless connection
Overhead projector
Instructor PC

Pros
Standard Classroom config
Has computer that are wireless

Cons
Tenuous internet connection
Difficult for instructor to help
No dual monitors for students
Future State (now current state)
15 laptops
Lan line connections
3 - 55” TVs
Instructor PC
Remote Lab Area
with 4 rack mounted PCs
Common remote area

Pros
Unique Classroom config
Has computer that are on lan line
Instructor has easy access to students
55” Monitors provide dual monitor
Modifiable Remote Lab Area

Cons
Cost for added lan lines
Cost for power
Cost for IP cameras ~ 200 each
Cost of 55” TVs ~ 500 each
Possible loss of classroom
TC1337 – Options for remote lab equipment

Remote Lab Area – Data Acquisition & Control

Option 1 - cRIO ~ 5K each
new technology
matches MECH-NET config
Expandable & more like industry
Supplement Your Control or Measurement System with NI Remote I/O
MECH-NET http://www.mech-net.com/
Developing Remote and Virtual Laboratories with LabVIEW

Option 2 - Elvis II ~ 3K each
We already have 9 of them
Adaptable for mechanical or electrical
Has already been done at other schools
Open University talk on "An Internet of Laboratory Things" working in practice
https://www.youtube.com/watch?v=k6-WxUoXh4M
Using NI ELVIS and LabVIEW for Remote Engineering Electronics Experiments

Option 3 - myRIO & myDAQ ~ 1K each
We already have 4 sets
Potential for inverted lab (student owned)
Very inexpensive with lots of support
Many schools use them
IMPROVING LEARNING OUTCOMES IN EE2010L USING NI MYDAQ IN AN INVERTED LAB
Remote Lab Area - Computing

Computing with USB interface
4 rack mounted PCs ~ 800 each
Monitor with keyboard mouse ~ 600
Rack ~ 600

Dell PowerEdge R230 - rack-mountable
Xeon E3-1220V6 3 GHz - 8 GB - 1 TB
$806.66

Tripp Lite KVM Rack Console w/ 19" LCD in 1URM Steel Drawer w Cable Kit
$627.88

StarTech.com 22U 36in Knock Down Server Rack Cabinet with Caster
$607.12

TC1337 – GRE PCs with local admin rights
Remote Lab Area – Experiments
We already own much of this
No place to put it

Experiments on wheels
• Pasco Bridge
• Shake Table
• Mechanical
• Material Science
• MEMS
• Electronics
6 Remote Access labs using relays, NI myDAQ and breadboard

3 Remote Access labs using NI ELVIS IIIs

TC1337 – Current State – Electronics
Used in EECT 111, 112, 121, 211 courses

https://www.ivytechengineering.com/abell118/files/2020ATMAE_Workshop.mp4
Virtual Reality
What is Second Life?

Ans – Second Life is a virtual reality that is accessible via the internet. You download a viewer, create an avatar and explore by walking, running, flying or teleporting. It is like playing a video game.

Is it used by other colleges?

Ans – Second Life has been used by many colleges. The peak usage was about 10 years ago but many colleges jumped in and didn’t have a good game plan for the use of Second Life.

How do we get it?

Ans – The Second Life Viewer is free to download but if you want to build something you should buy some land.

Original inspiration: Engineering Education Island: Teaching Engineering in Virtual Worlds

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You don’t need your own island to explore. I looked at Evergreen Island 3 and other sites.

Explore, explore, explore
I was able to modify one of the multimedia screens and changed the URL to Ivy Tech

*Progress sometimes starts with change*
Flying, teleporting, walking, sitting and running are all movements you can make in Second Life.

Exploring is essential for learning.

Found another place in Second Life and talked to another educator to get ideas.

Networking is essential for success.
IvyTech Engineering Island

In April 2020 Ivy Tech purchased a pre-made island (Horizon Community Center) for ~ $100 per month and $1500 worth of Linden Dollars for the Second Life Marketplace.

https://www.connect.secondlife.com/explore
http://maps.secondlife.com/secondlife/IvyTech%20Engineering%20Island/206/120/21
What do we want to do with Second Life?

Ans – get back to the state of “Engineering Education Island: Teaching Engineering in Virtual Worlds”

What do we want to do with Second Life?

Ans – Build a virtual cleanroom. Currently, we do not have the space or funds to build a clean room (this would cost in excess of 2 million dollars with a sizeable annual budget needed for material, equipment maintenance and supplies ~ 50K per year. But if we build a virtual clean room we could give the experience without the cost.

Status – in progress...
Examples of Second Life Presentations @ Ivy Tech (2020-2021)

Second Life Presentations
https://www.youtube.com/watch?v=o3S8sou4oUQ

Second Life Intro
https://www.youtube.com/watch?v=QrWtgERTplg

Wire Resistance Presentation in Second Life
https://www.youtube.com/watch?v=Il_cQQE4SeQ

Mini-Lou in Second Life
https://www.youtube.com/watch?v=Qx7YvJmB_3o

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Student presentations are recorded with Zoom but presented in Second Life. Presentations are as easy as uploading a single image to a webpage.

Students enjoy presenting in Second Life. They pick their own avatar and explore the IvyTech Engineering Island and beyond …
Imagination will often carry us to worlds that never were. But without it we go nowhere. – Carl Sagan
Kits to take home
What are “kits”?

A kit allows users to conduct experiments from home at minimum cost. Initially, kits were distributed and paid for by the engineering program at a cost of ~ $100 per student. However, in 2019 we were able to secure a vendor who would build the kits and sell them to the Barnes and Noble bookstore. Students could then purchase the kits from the bookstore to use in class as part of their “hands on learning” using their financial aid.

Two kits were developed for EECT 111 Intro To Circuits Analysis and EECT 112 Digital Fundamentals. Parts from two vendors (Electronix Express and Jameco) were selected based on the ~ 20 labs that we typically do for these two courses. Quotes were provided and we selected Electronix Express. The new kits received part numbers and the bookstore could order and stock the kits in the bookstore.

Our reasons are
1.) Need for social distance
2.) Reduce cost to department budget
3.) Put electronics in the hands of students to own
4.) Emphasize the need for “hands on learning
Students access the lab instructions via Canvas (Ivy Learn). Software is provided via NI as part of our site license agreement and the kits are what the students can buy in the bookstore.
Kit info – what’s in the EECT 111 Intro To Circuits Analysis kit?

Students can buy kits from the bookstore and use their financial aid.

EECT111 ELEC.KIT-32IVTFWEEECT111by 550218717 (2818440022630)

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$55.44
Kit info – What is missing can be supplemented with remote labs using MyDAQs and ELVIS IIIs

If necessary, kits can be supplemented with remote labs. Labs 11 and 13 for the EECT 111 class use remote labs.
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$43.46

### EECT 112 Kit

**Students can buy kits from the bookstore and use their financial aid.**

**EECT112 ELEC.KIT-32IVFTWEECT112 by 550218725 (2818440022647)**

Kit info – what’s in the EECT 112 Digital Fundamentals kit?

Also added by the department were items bought through Amazon:

- 3.3V 5V Power Supply Module for MB102 102 Prototype Breadboard DC 6.5-12V or USB Power Supply Module
- 9V Battery Clip with 2.1mm X 5.5mm Male DC Plug
Most challenging EECT 112 lab is lab 9, lab also supported with Custom LabView program for 555 Design.

Kit info – What is missing can be supplemented with LabView programs and remote labs (under development).
Numerous custom LabView programs have been created and are easily deployed to the GRE computers. Admin rights are maintained by the department …
Questions and References

https://www.ivytechengineering.com/abell118/references/SecondLifeInfo/

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SL avatar = ivytechengineer

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http://www.ivytechengineering.com/abell118