Remote Lab Design and Development to Support MEMS Education

AGBell 11/09/2018

IVY TECH COMMUNITY COLLEGE

Remote Lab Design and Development to Support MEMS Education
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This *presentation* will discuss the concept of using a remote lab to support the teaching of MEMS and engineering concepts. What is a remote lab? A remote lab allows students to interface to experiments and equipment that are in a remote location. Remote labs allow colleges to maximum the use of expensive equipment via the internet. Teaching MEMS concepts can necessity the use of cleanroom and other equipment that may not be readily available at all colleges. Online courses further accent the need for remote access to equipment to fulfill the need for “hands on” learning. Application of these concepts can support IoT (Internet of Things), aerodynamics, precision agriculture, cyber security and other applications at a college and reduce the required footprint to provide a quality education.

For some reason my abstract is very long in the app, maybe because they duplicated?

What is a remote lab?

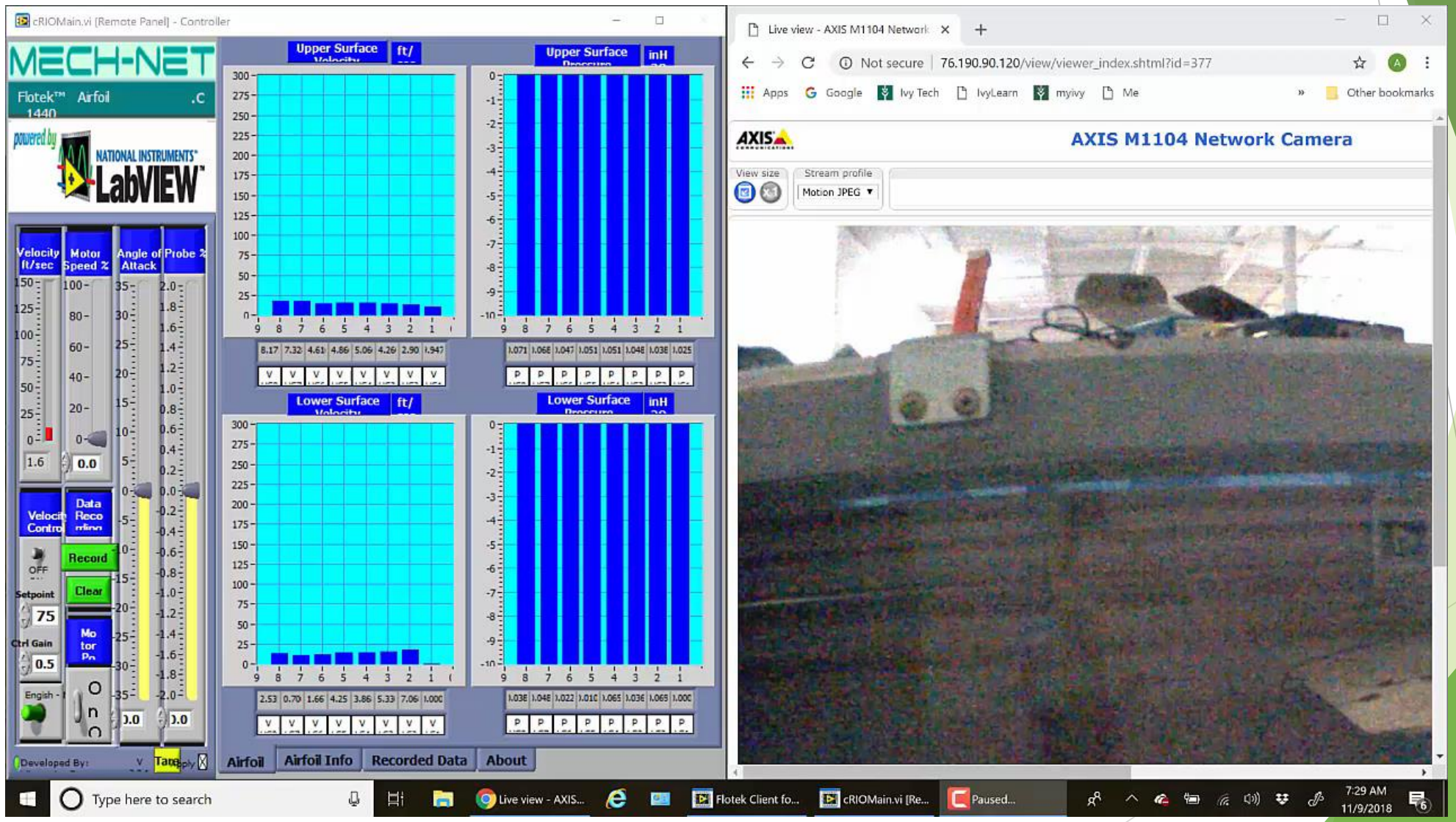
A remote lab allows users to interface to experiments and equipment that are in a remote location. Remote labs are conceptually related to the “Internet of Things” IoT

Our model for Remote Lab is MECH-NET (http://www.mech-net.com/)
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)[1]
2.) improved learning for students[2]
3.) better use of equipment that is currently under utilized[3]
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 EE2010l Using NI MYDAQ in an Inverted Lab
3 – Last inventory show we have ~ 175K of equipment from TecQuipment (not being used)

And now for the movie

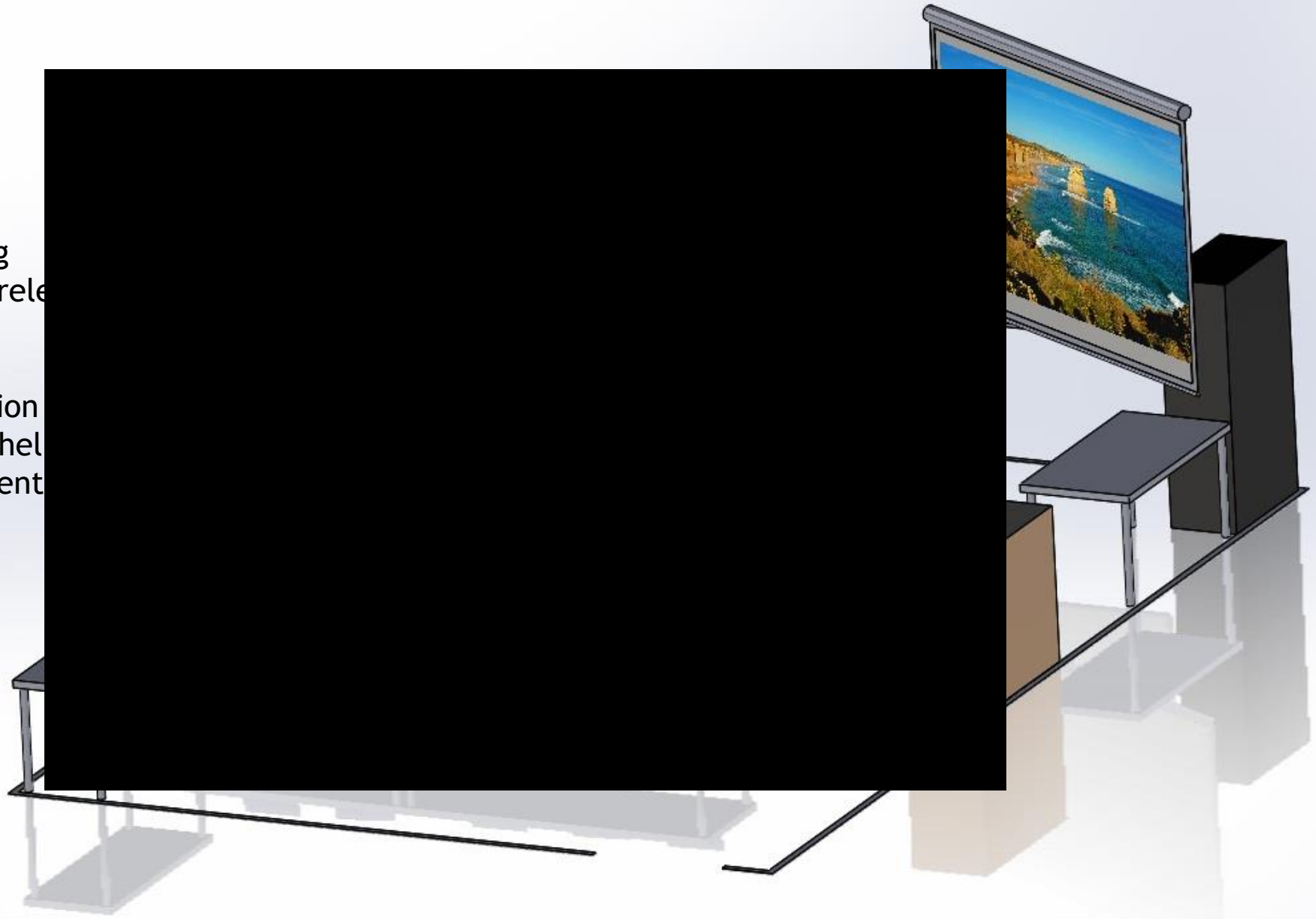


Present State -TC1337

15 laptops
Wireless connection
Overhead projector
Instructor PC

Pros
Standard Classroom config
Has computer that are wirele

Cons
Tenuous internet connection
Difficult for instructor to hel
No dual monitors for student

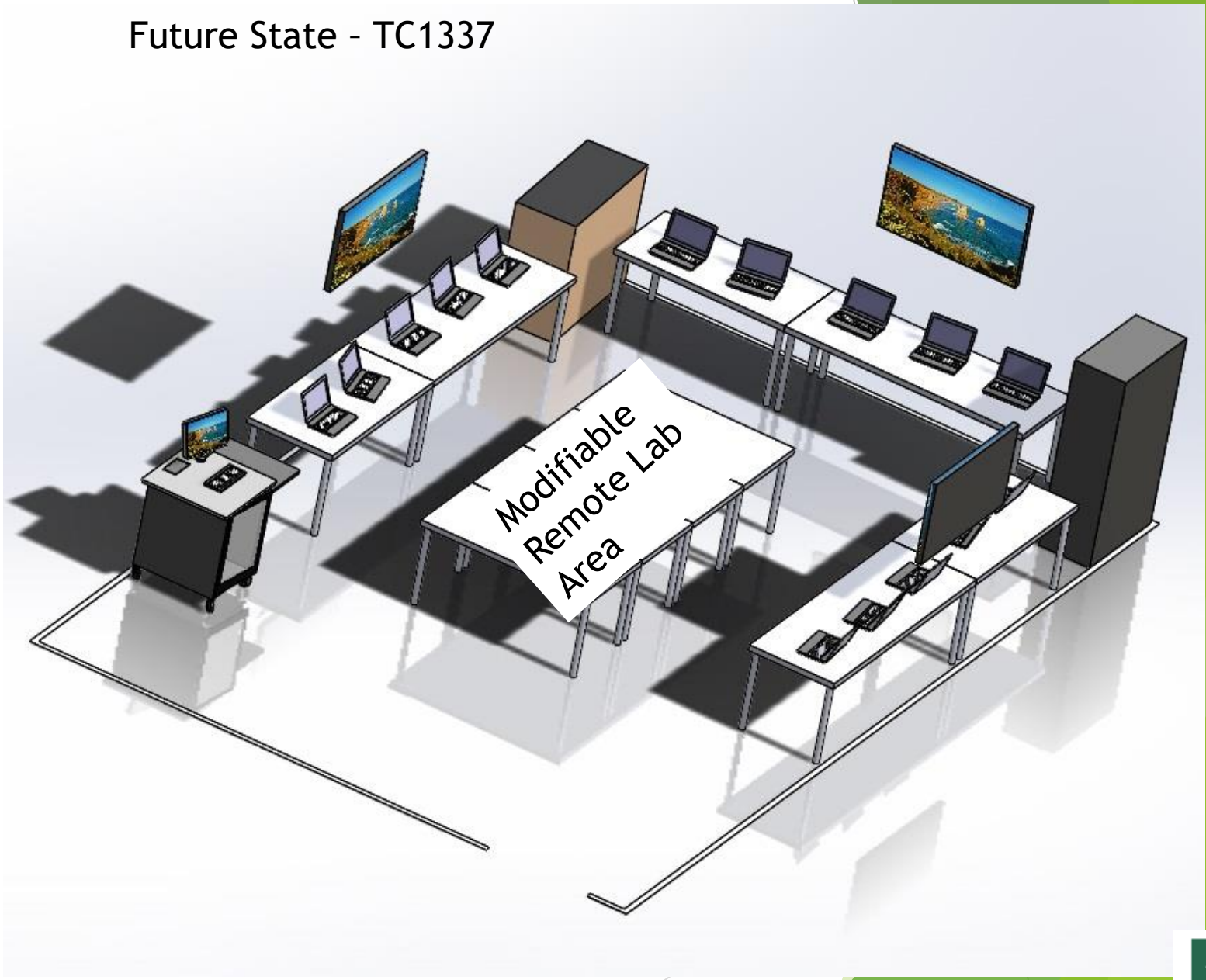


Future State – TC1337

15 laptops
Lan line connection
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



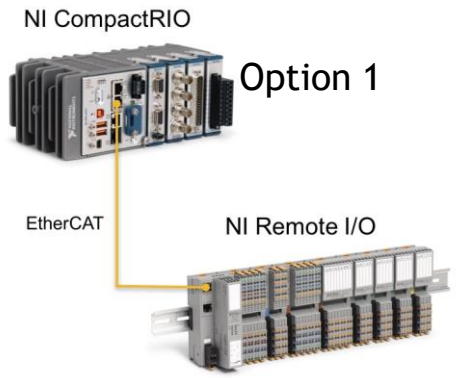
Data Acquisition & Control

Remote Lab Area – Data Acquisition & Control using NI products

Option 1 - cRIO ~ 5K each
new technology
matches MECH-NET config
Expandable & more like industry

Option 2 - Elvis III ~ 3K each
We already have 9 Elvis II +
Adaptable for mechanical or electrical
Has already been done at other schools1, 2

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



Computing and Network

Remote Lab Area – Computing & Networking

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

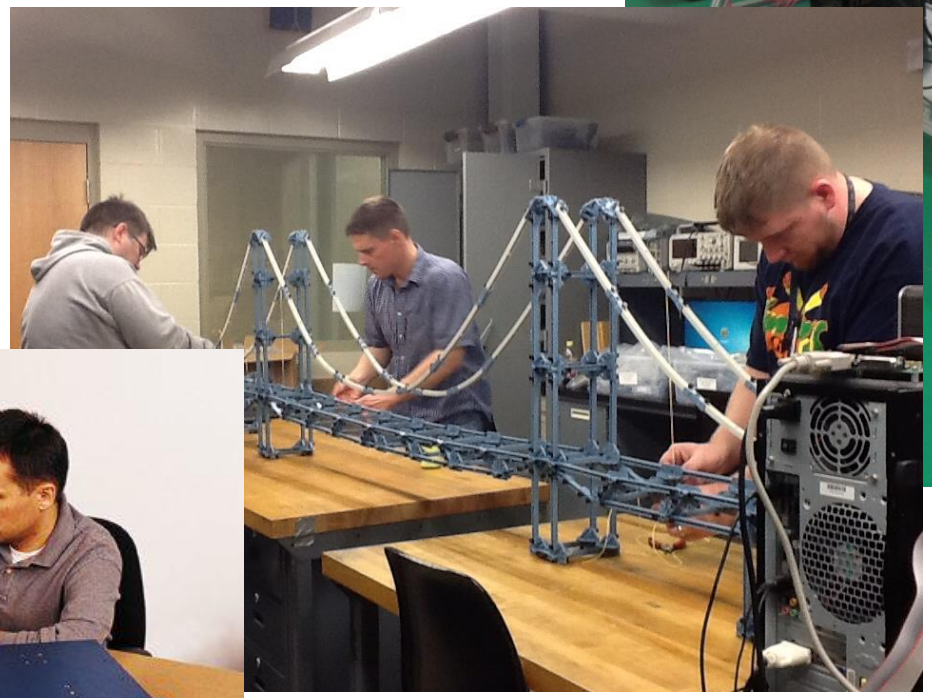
StarTech.com 22U 36in Knock Down Server Rack Cabinet with Caster
$607.12

Experiments & labs

Remote Lab Area – Experiments
We already own much of this
No place to put it!

Experiments on wheels

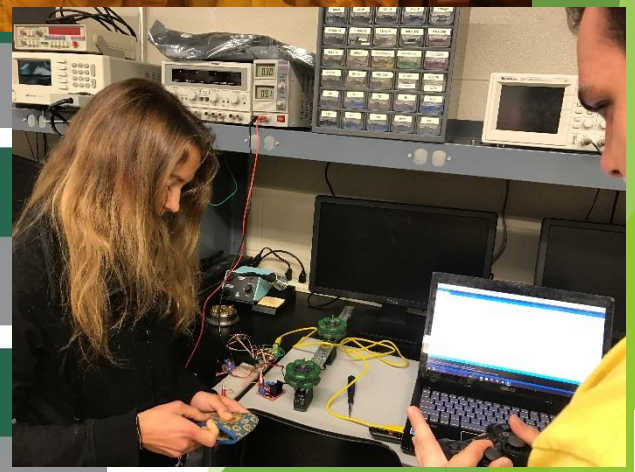
- Pasco Bridge
- Shake Table
- Mechanical
- Material Science
- MEMS
- Electronics



We are still working on it.

Will be used in many courses to support all engineering programs

More on Ivy Tech MEMS
http://www.ivytech-mems.org



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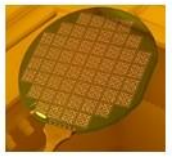
Questions?

MEMS 101
Introduction to Microsystems



MEMS 102
Microsystems Characterization

MEMS 103
Microsystems and Electronics

Option 1

1 - Supplement Your Control or Measurement System with NI Remote I/O
http://www.ni.com/white-paper/53388/en/

2 - MECH-NET http://www.mech-net.com/

3 - Developing Remote and Virtual Laboratories with LabVIEW
http://sine.ni.com/cs/app/doc/p/id/cs-13030

Option 2

4 - Open University talk on "An Internet of Laboratory Things" working in practice
https://www.youtube.com/watch?v=v-k8-WXgNEM

5 - Using NI ELVIS and LabVIEW for Remote Engineering Electronics Experiments
http://sine.ni.com/cs/app/doc/p/id/cs-14002

Option 3

6 - Improving Learning Outcomes in EE2010L Using NI MYDAQ in an Inverted Lab
https://corescholar.libraries.wright.edu/etd_all/1243/

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