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Innovative Learning ... Promising Future
THE RITZ-CARLTON, RIYADH

المؤتمر الدولي الرابع للتعلم الإلكتروني و التعليم عن بعد
11 - 14 جمادى الأول 1436 هـ / 2 - 5 مارس 2015 م
تعلم مبتكر .. لمستقبل واعد
الرتز كارلتون - الرياض

e-Laboratory for Mechatronics Engineering Courses:

An Innovative Laboratory for Distance Learning

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مختبر لدورات هندسة الميكاترونكس
ابتكار مختبر للتعلم عن بعد

الدكتور زول بهري بن رزال

Aim of 'hands-on' in laboratory classes – to gain **experience** and **technical knowledge** (Christiansen F.V 2007)

Experience developed *by **performing** the laboratory exercises (intentionally / unintentionally) (Trevelyan J.P 2007)*

Scenario towards e-Lab

- high cost of traditional or hands-on laboratory classes
- need for distance learning
- trend towards providing online laboratory classes through electronics access

Scenario towards e-Lab

- e-Lab class can offer cost savings
- made possible by advancements in software and communication technologies

However:

- The technology has not been widely adopted elsewhere.
- Engineering laboratory classes still follow traditional patterns

Why:

- It is worth asking why the adoption of such an attractive technology has been so much slower than expected.

Why:

- To answer this question we (UniMAP) started a project to understand more about the practical learning outcomes from traditional and e-Lab classes.

Traditional Lab (hands-on lab)

vs.

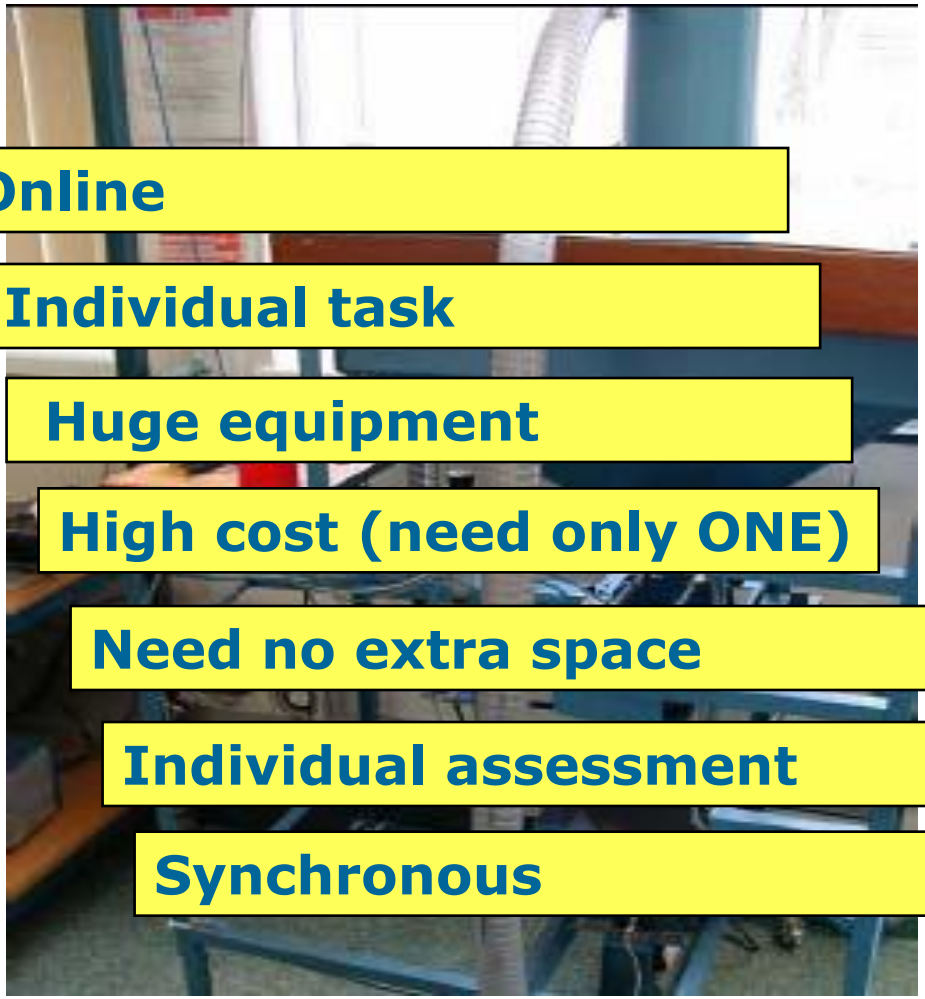
e-Lab (online lab)

Traditional Lab (pump rigs)

Traditional Lab (pump rigs)

e-Lab (sand weighing machine)

e-Lab (sand weighing machine)

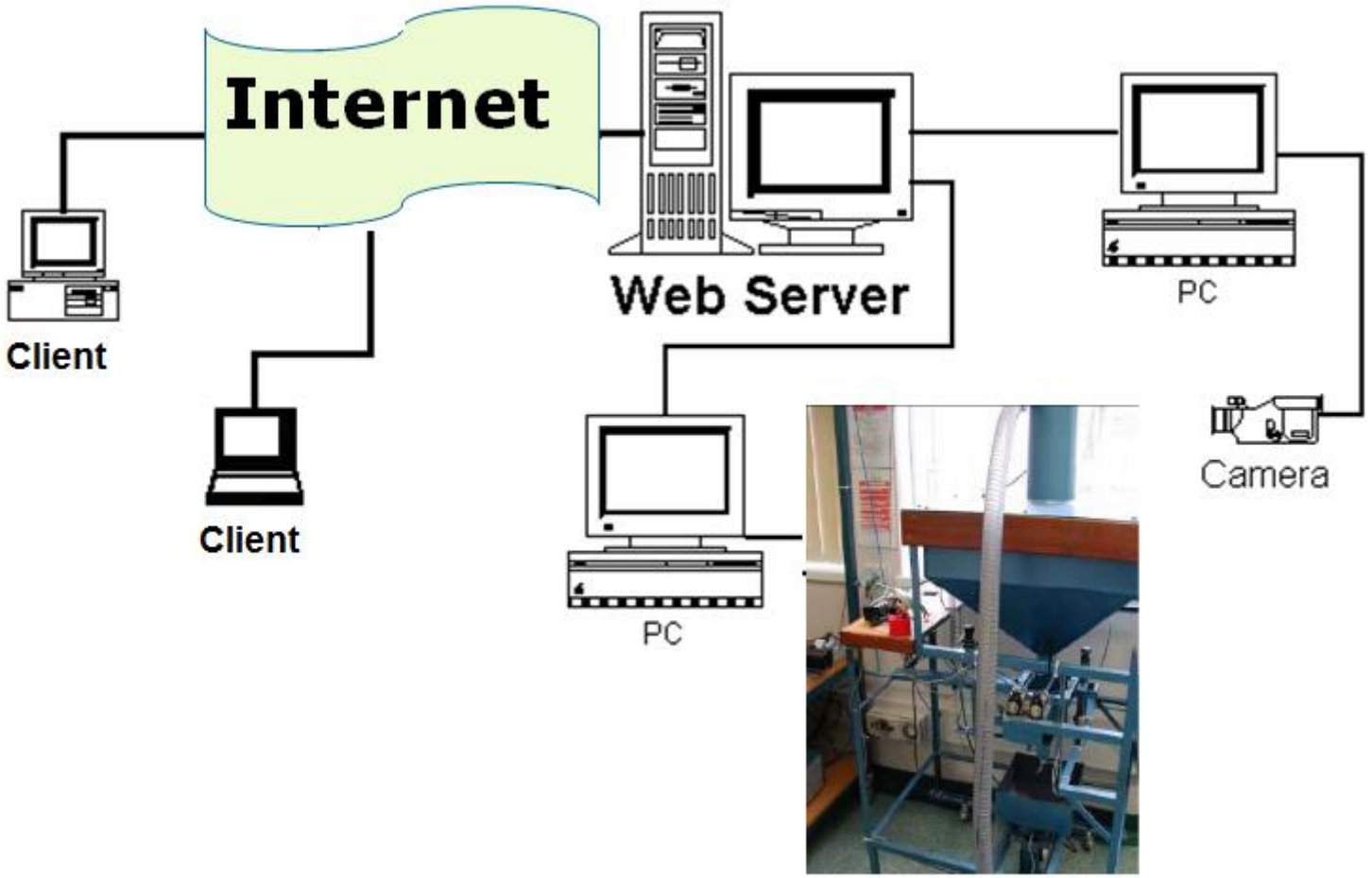


- Online
- Individual task
- Huge equipment
- High cost (need only ONE)
- Need no extra space
- Individual assessment
- Synchronous

e-Lab Structure

- Computers in the **e-Lab** are connected to instrument (Sand Weighing Machine).
- When students log in to these machines over the Internet, they are able to control both the computer and the equipment.
- It does not matter if the student is in a nearby dorm room or on the other side of the world.

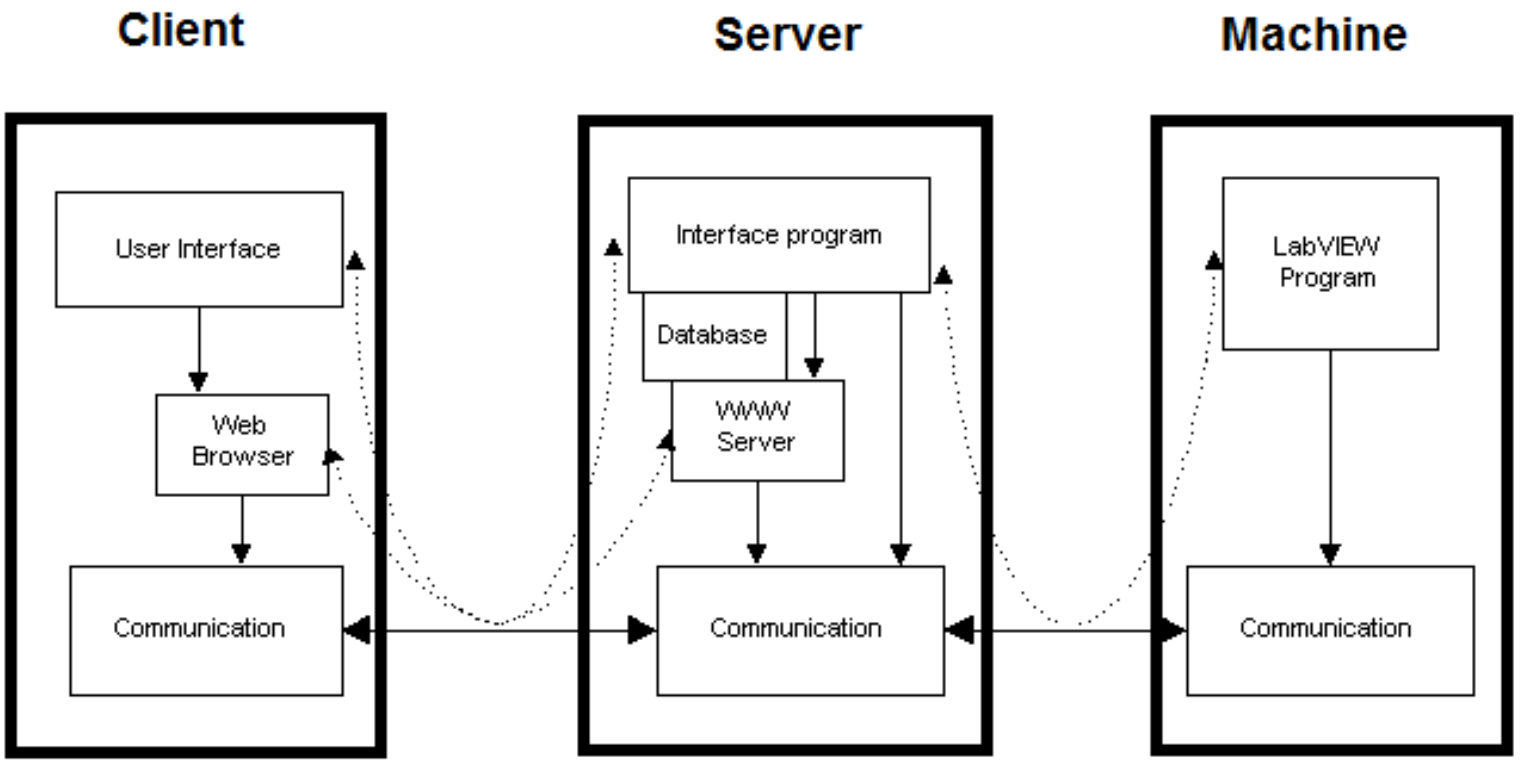
e-Lab Structure



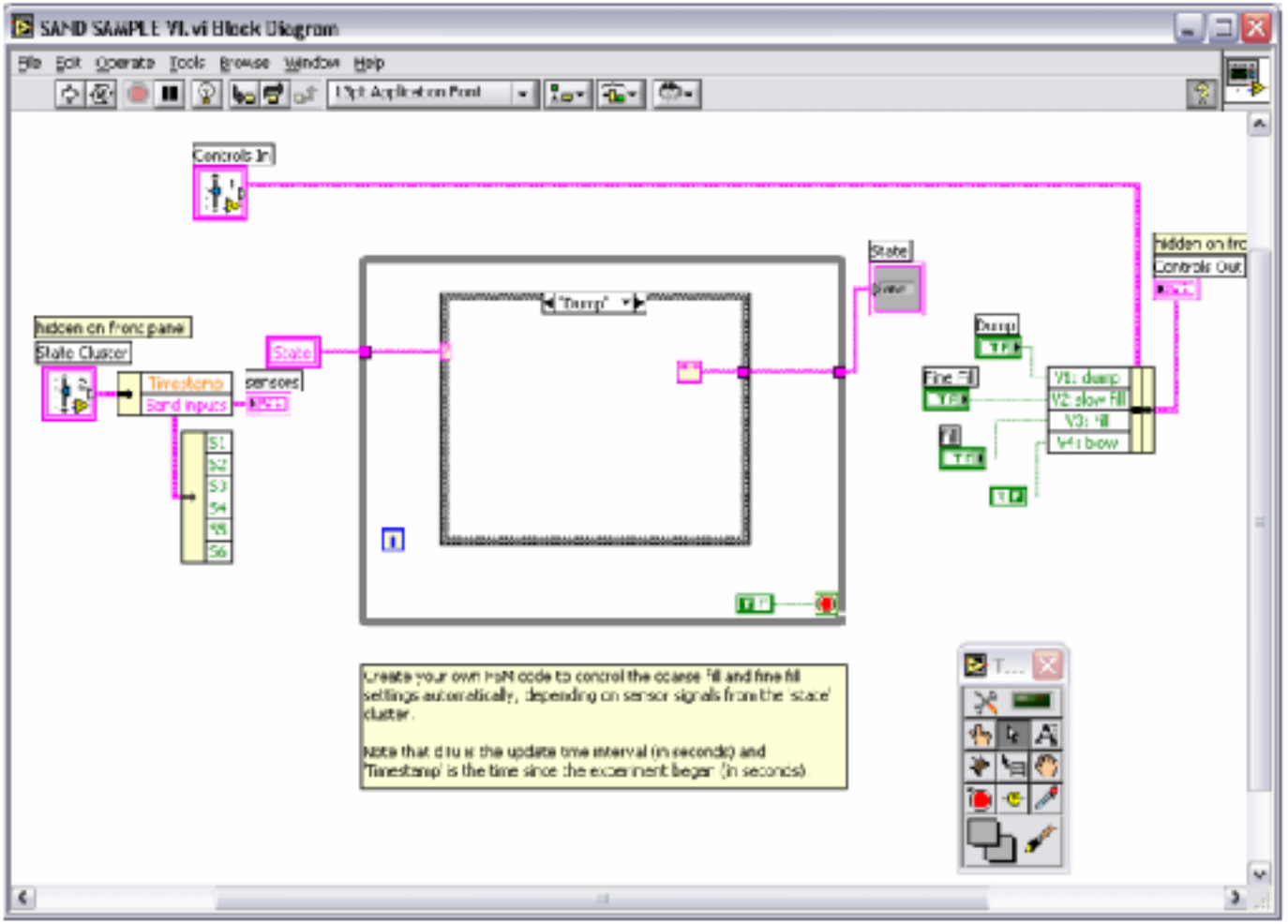
Hardware Architecture

- PC computer with data acquisition card, GPIB interface card and Ethernet card.
- Programmable Instruments with GPIB cable.
- PC computer with a video camera and an Internet-based video server, (the user will feel that he/she controls the real instruments electronically instead of simulators.)

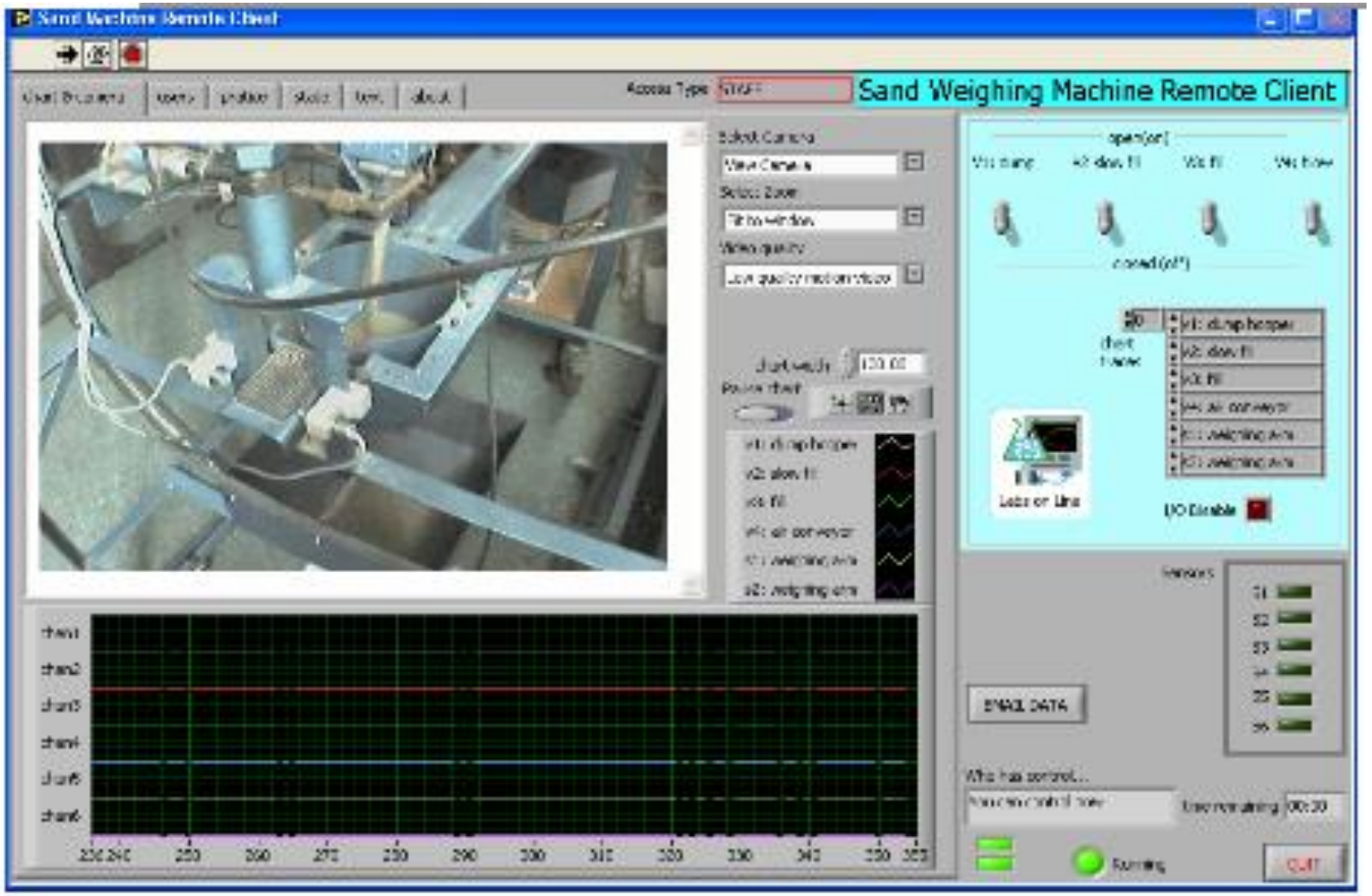
Communication Setup



e-Lab Clients Setup (LabView)



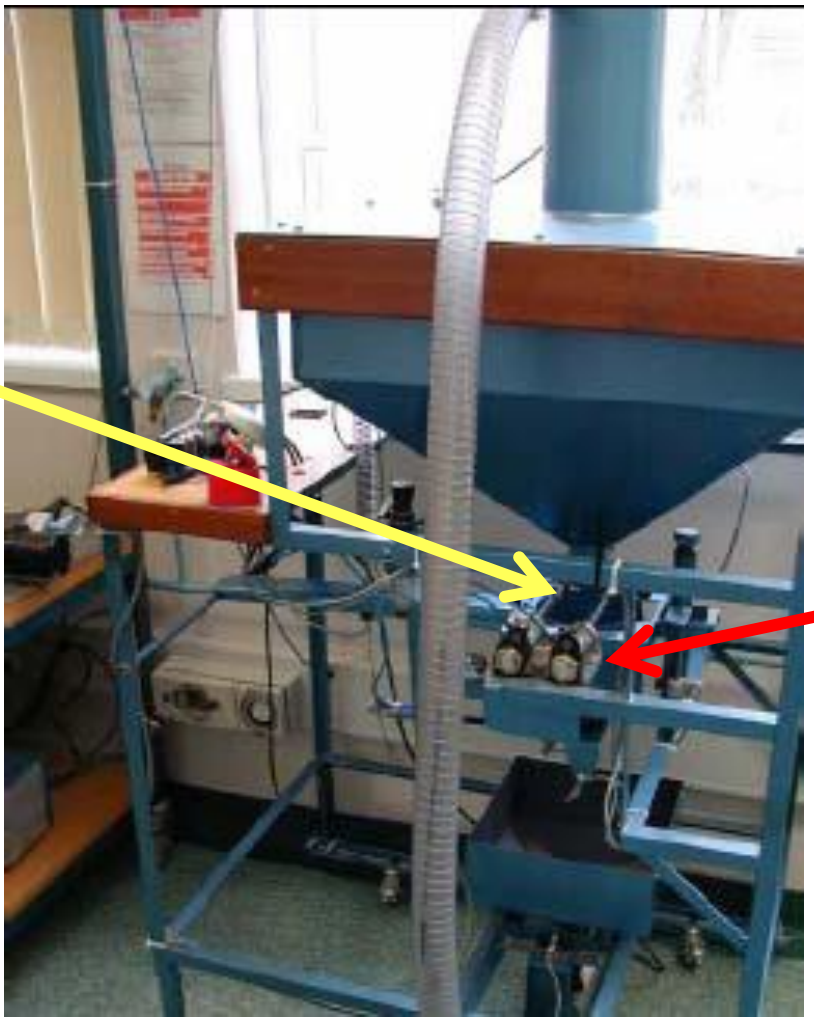
e-Lab Clients Setup (LabView)



e-Lab Machine Setup

Controlled pneumatic actuators

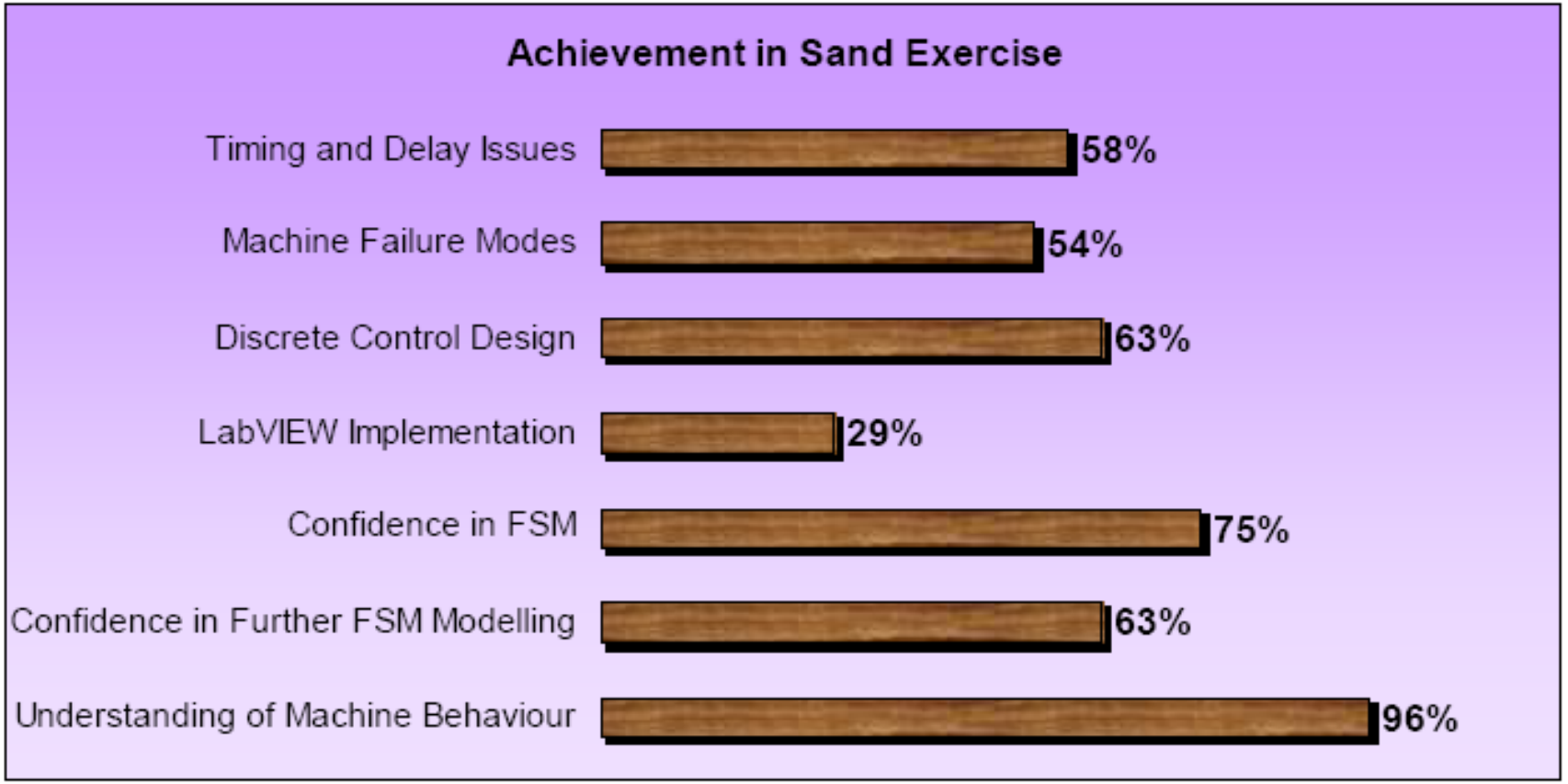
(controlled via interface)



sensors

Results

- Results from the Sand Weighing Machine experiment indicated a positive learning experience from students.
- An almost perfect achievement was obtained for equipment understanding


Achievement in Sand Exercise
Timing and Delay Issues
58%
Machine Failure Modes
54%
Discrete Control Design
63%
LabVIEW Implementation
29%
Confidence in FSM
75%
Confidence in Further FSM Modelling
63%
Understanding of Machine Behaviour
96%

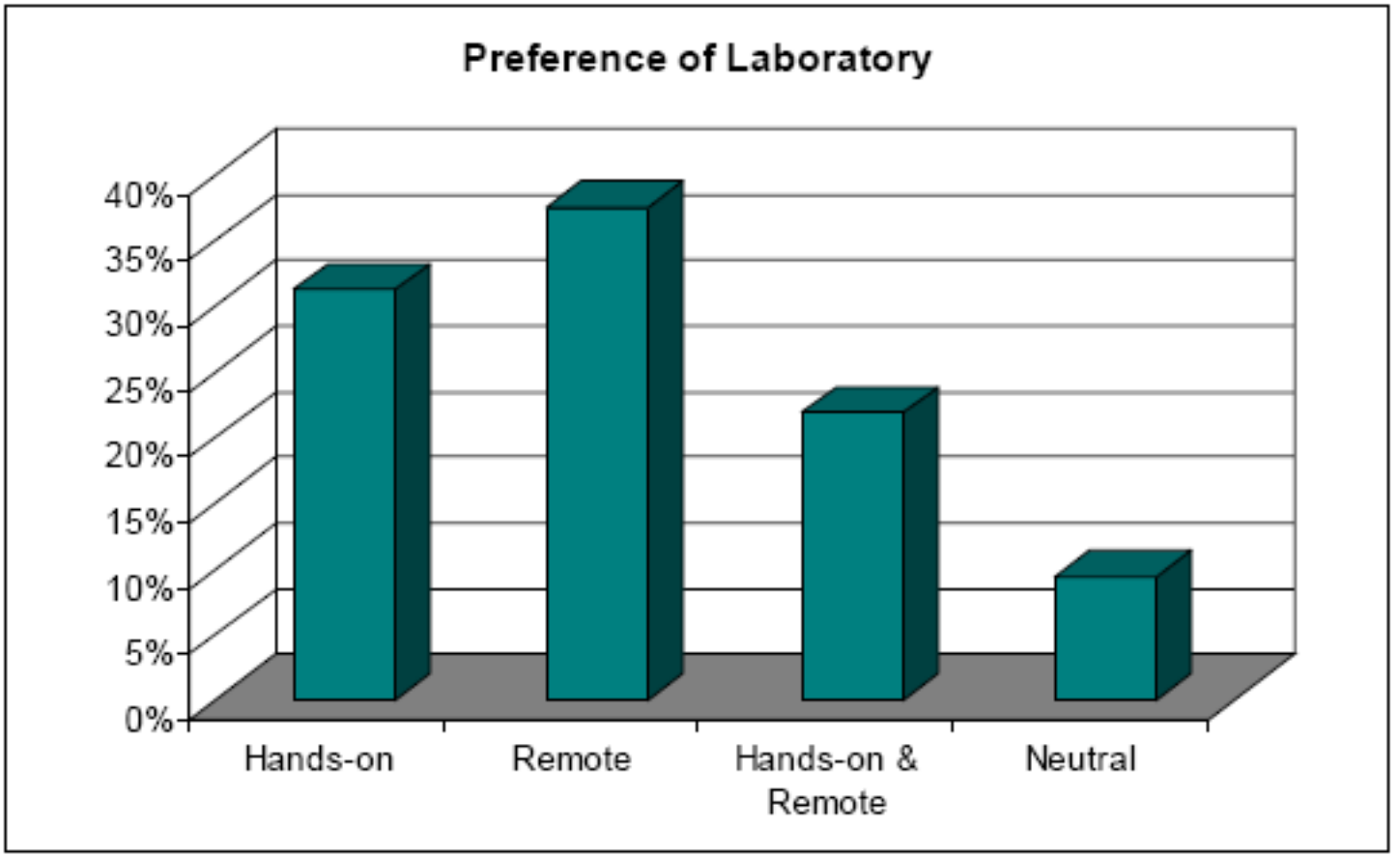
Results

- Outcomes from the e-Lab is more varied compared to the Traditional Lab.
- e-Lab experiment achieve outcomes similar to each students and with greater success.

Results

Average Weighted Outcome	%	Mean	Std Dev
Sand machine e-Lab exercise	63%	0.7488	0.1158
Pump hands-on laboratory	57%	0.7487	0.1262

Results


Preference of Laboratory
40%
35%
30%
25%
20%
15%
10%
5%
0%
Hands-on
Remote
Hands-on & Remote
Neutral

Conclusions

- Relative effectiveness of hands-on and e-Labs.
- Discussed results from the assessment study that directly compared e-Lab and hands-on laboratories.
- The effectiveness and impact of the e-Lab to be comparable (or better) than the hands-on labs.

Thanks for paying attention