

Cloud E-learning for Mechatronics: CLEM

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- Challenges in Mechatronic E-Learning
- CLEM Overview
- E-Learning
- Remote and Virtual labs
- Cloud Properties and Service Models
- CLEM Architecture and Implementation
- Evaluation
- Conclusion

Mechatronics and E-Learning



- Mechatronics combines the disciplines of electronics, mechanics and computer science.
- Robots, CNC machines and others devices – scarce resources
- Time and resources constraint – trainers and devices

Introduction - 1



- EU Funded Project including 7 partners over 6 countries
- CLEM, an infrastructure for e-learning based on cloud services
- A domain-specific cloud that is especially tuned to the needs of VET (Vocational, Education and Training) teachers.
- Remote labs
- Learners accessing such laboratories to support their practical learning of mechatronics without need to set up laboratories at their own institutions.

Introduction - 2



- CLEM designed to be a platform to allow e-learning resources that can be interoperable and sharable in the e-learning community
- A new and dynamic method of teaching through which teachers and trainers can impart industry-ready knowledge and develop relevant skills

- Students like to see learning materials online as well as being presented in a classroom as it gives them more opportunity to learn and greater location freedom.
- Utilization of Internet or Web and Multimedia
- Use of virtual and remote labs

Three Types of Remote Labs



- Batched
 - Whole experiment defined in advance and instructions sent
 - Experiment runs without user interaction
- Interactive
 - User is able to change parameters as the experiment runs
- Monitoring
 - Sensors used to collect data
 - Device controlled automatically
 - No interaction during experiment
 - User simply monitors

- Recreation (Virtual Lab) –OpenScience
 - Data from real experiments collected
 - Real images collected
 - Data and images used to recreate the experiment
- Simulation (Virtual Lab) - EjS , Matlab
 - Mathematical models providing foundation
 - Graphics and visualisations controlled by mathematical models according to user input

Remote Labs



- Actualisation (Remote Lab) – iLab, CLEM, LabView, Arduino Labs at HOU
 - Real Devices connected to software controllers
 - Real Devices operated by instructions provided through the software
 - Camera used to show device in action in real-time
- Community Support and Innovation (Added Value) – CLEM
 - Services provided to enable users to set up laboratories, add materials or set up own cloud
 - Expert channel
 - Community channel
 - Facilities provided to enable users to tailor and set up courses easily

Cloud Properties



- National Institute of Standards and Terminology (NIST)
 - On-demand self-service
 - Broad network access
 - Resource pooling
 - Rapid elasticity
 - Measured service

- Cloud
 - A service provider providing computational resources to clients /consumers according to their demands without requiring human interaction.
- CLEM
 - to deliver e-learning resources to teachers and learners based on their demands.
 - Teachers and learners reserving the required resources through a booking system.
 - For hard resources, the scheduling service in the system automatically allocating and locking the resources to the client who booked.
 - For the soft resources, making instances and allocating the required memory to store the states

- Cloud
 - The resources and capabilities in the cloud accessible or available over the network and accessed by heterogeneous thin or thick client devices (e.g. mobile phones, laptops, and tablets).
- CLEM
 - accessible at anytime and anywhere by any device.

Resource pooling



- Cloud
 - A cloud provider gathering heterogeneous computing resources into a pool to serve multiple consumers concurrently.
 - Dynamically allocating and reallocating physical and soft resources (e.g. storage, processing, memory, network bandwidth, and virtual machines) to the consumers based on their demands.
- The CLEM
 - designed to support multiple learners and trainers by collecting different soft resources in a pool, but not the hard resources.
 - The physical artefacts located in different places and managed by their local owners.
 - The resource owners registering themselves as members of the community to share their resources.
 - Gathering these resources and making them available to the users, but no ownership.

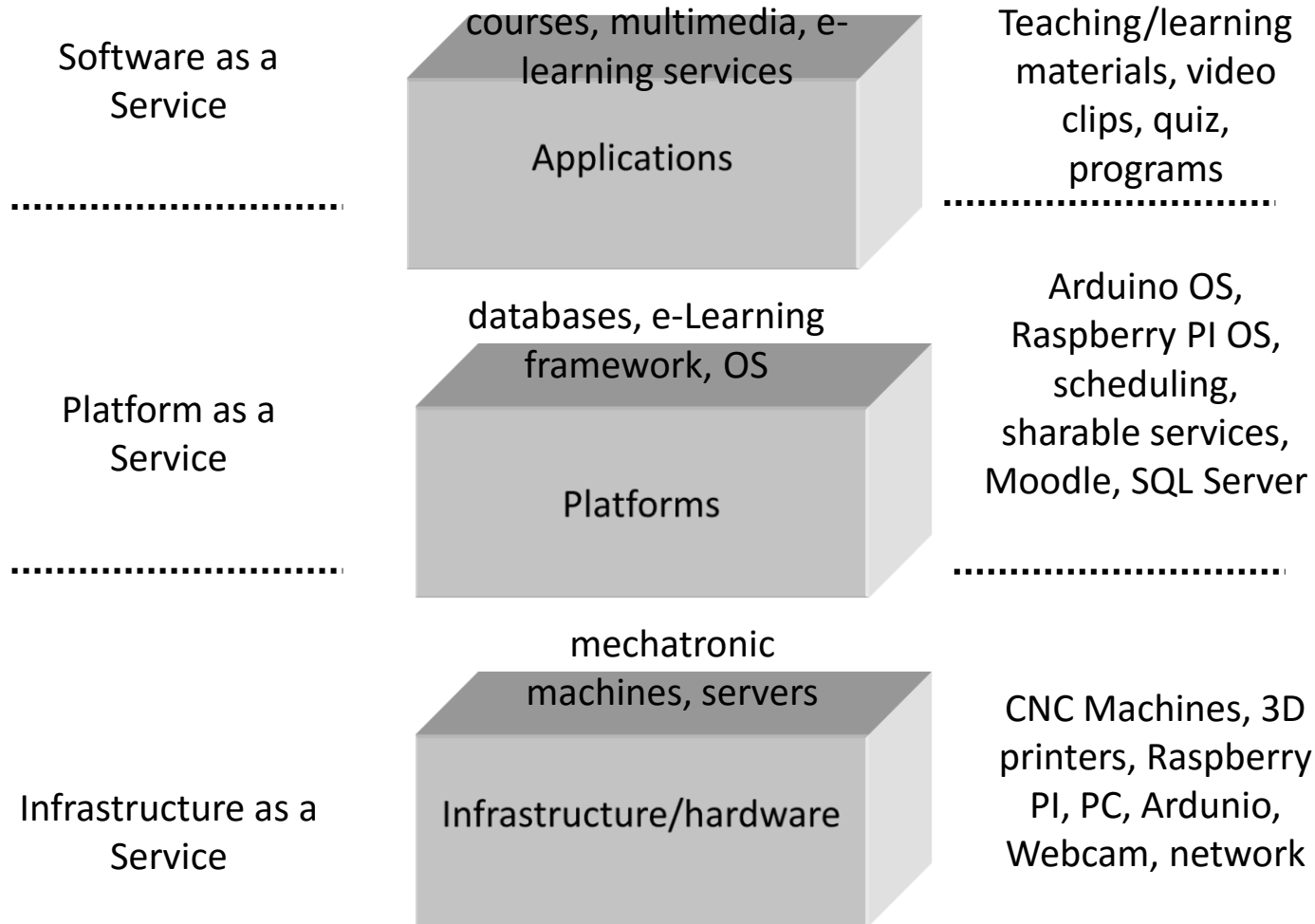
Rapid elasticity



- Cloud
 - The provision of resources and capabilities rapidly scaled up or down according to the demand,
 - elastic and on-demand computing paradigm.
- CLEM
 - a collection of resources contributed by the community which can meet the demands by involving more resources provided by community members or releasing them according to the demands.

- Cloud
 - A cloud system provides on-demand services with finance implications
 - measuring and metering the resource provided and consumed to provide transparency for both the provider and consumer of the utilized service systems.
- The CLEM
 - a free service for the trainers in the first instance.
 - a scheduling system to optimise its resources,
 - the trainers and learners booking their intended resource usages in advance in terms of time and size.

CLEM Service Model

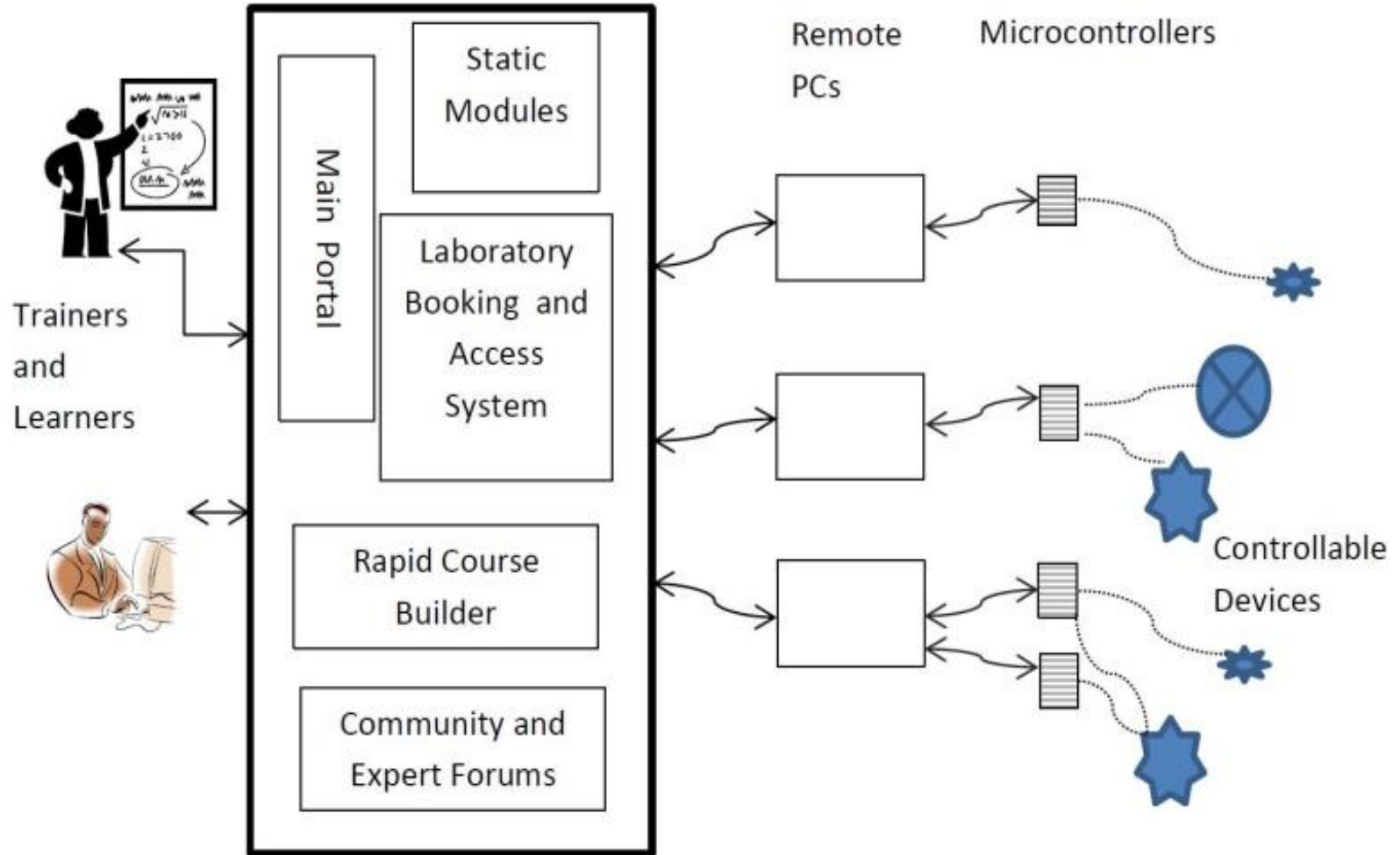


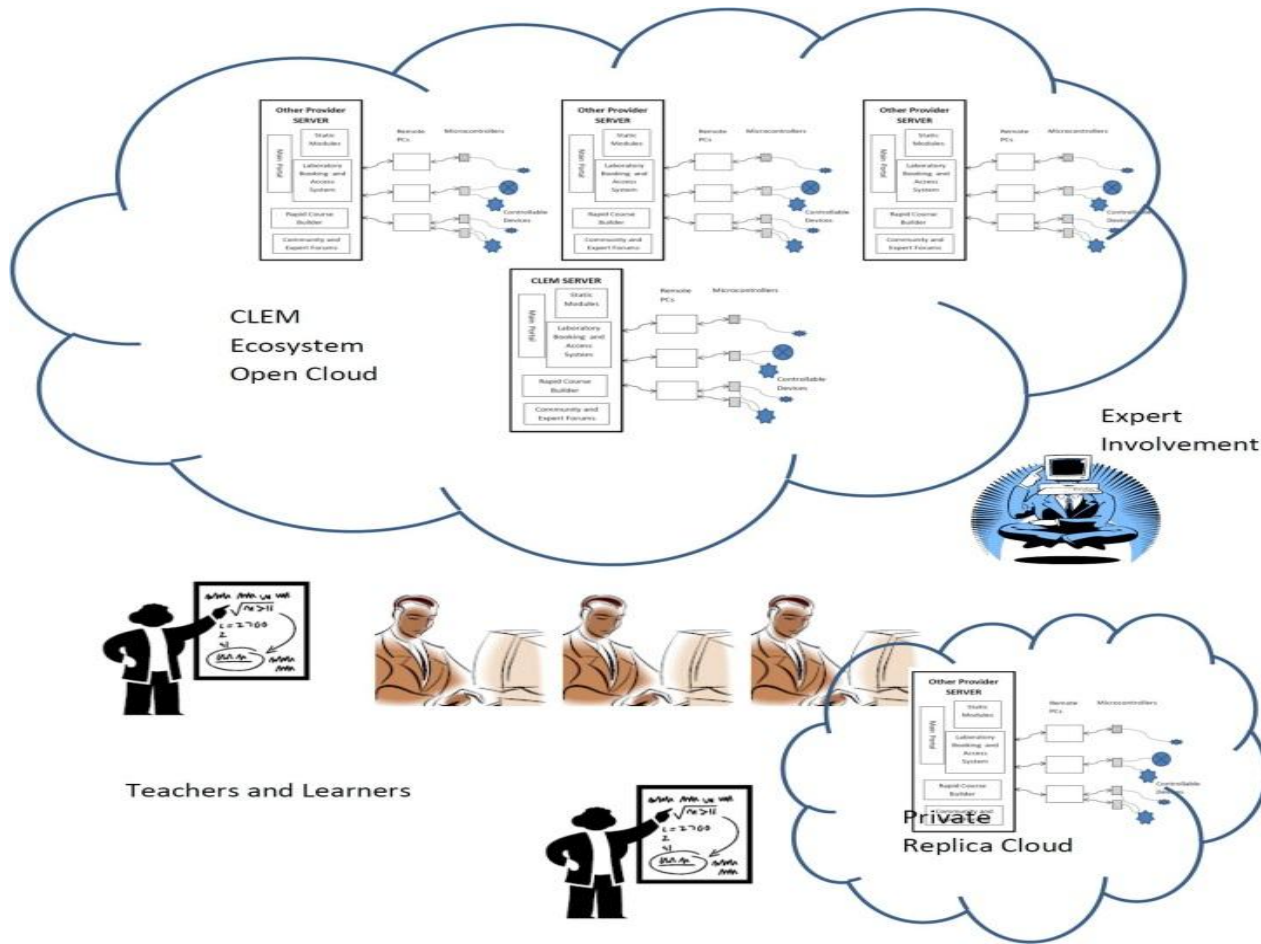
- E-Learning in the Cloud
 - the concept as Education Software-as-a-Service which tries to exploit the values of cloud computing to education.
- CloudIA
 - a framework designed for the students to create their own Java servlet environment for experimentation.
 - The focus to efficiently support on-demand virtual resources creation and management.

- Cloud computing improving e-learning processes in virtual e-universities to increase service reliability and reduction of cost.
- The BlueSky architecture with a number of cloud-based e-learning services to provide efficient resource management via pre-scheduling and pre-allocating resources for the high-demand applications prior to requests.

- Difficult to evaluate the benefits of cloud computing on e-learning
- No report about bringing in remote laboratories with physical machines and resources
- CLEM, the first system and platform which utilises cloud computing to create a community-based, dynamic e-learning system.

High Level Architecture





You are not logged in. ([Login](#))

CLEM Project

CLEM Project

Discover CLEM

CLEM is a site for educators and students to teach and learn mechatronics. Courses have been designed by experts in the field and are available to download and integrate into your local courses. You can take a quick look at our learning materials by clicking on the summary icon ⓘ for any CLEM module (situated on the right hand side of the module list). If you would like to share your material on this site, please download, complete, and return this [agreement](#) to contact@clem-project.eu. We only accept institutional and/or organisational e-mails. Happy exploring !

Virtual Meeting (Link to VROOM)

Virtual Laboratory (Link to Virtual Laboratory Suite)

CALENDAR ⓘ ⓘ

◀ April 2014 ▶

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

COMMENTS ⓘ ⓘ

ACTIVITIES ⓘ ⓘ

basiclis
 Forums

COURSES ⓘ ⓘ

Introduction to Mechatronics (provided by University of Ruse "Angel Kanchev")
 Sensors and Transducers (provided by University of Ruse "Angel Kanchev")
 Actuators and Control (provided by the University of Cassino and Southern Lazio)
 Robotics and Biomechatronics (provided by the Technical University of Cluj and Napaco)

Courses

▼ CLEM Modules

- Introduction to Mechatronics (provided by University of Ruse "Angel Kanchev") ⓘ ⓘ
- Sensors and Transducers (provided by University of Ruse "Angel Kanchev") ⓘ ⓘ
- Actuators and Control (provided by the University of Cassino and Southern Lazio) ⓘ ⓘ
- Robotics and Biomechatronics (provided by the Technical University of Cluj and Napaco) ⓘ ⓘ

Sample Slide

clem.coventry.ac.uk/CASSINO/Lesson2/display.html

Pneumatic Motors



Vane types

1. used to very high speed from 1000 to 30000 rpm;
2. may offer uni-directional or bi-directional rotation according to their design use;
3. medium-to-high-speed applications at low torque;
4. add reduction gears to give low-speed/high-torque capabilities.

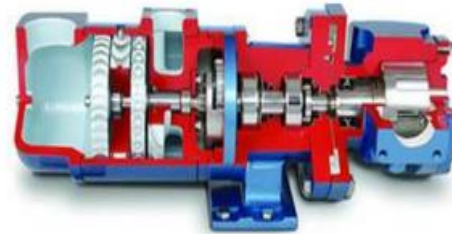


Fig. 17 A view of vane-type air motor.

Radial Pistons

1. not require reduction gearing for most low-speed/high-torque applications;
2. force from half the pistons is driving the crankshaft to turn it while the remaining pistons are exhausting;
3. inlet-outlet ports connected to a rotary valve driven by the crankshaft send 40 to 100 psi air;
4. run at less than 500 rpm due to air energy waste at faster speeds;
5. can be physically large and take a lot of mounting space;
6. make axial or in-line piston motors or gear-rotor designs.

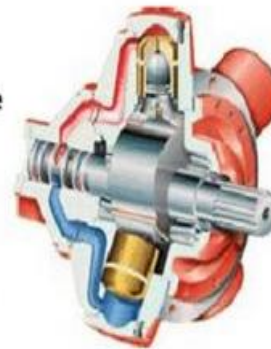


Fig. 18 A view of radial-piston air motor.

Booking System



← → ↻ dcm.coventry.ac.uk/arduino/schedule.php

Cloud services for E-learning in Mechatronics Home Board Configuration Remote Testing **Schedule** About Us

Hi an75824 ▾

Schedule a slot for testing a lab

Date and Time on the Server:

Sunday 13 Apr 16:34 2014
Europe/London

Select Date:

April ▾ 2014 ▾

	Mo	Tu	We	Th	Fr	Sa	Su
14	31	X	X	X	X	5	6
15	X	8	9	10	11	12	13
16	14	15	16	17	18	19	20
17	21	22	23	24	25	26	27
18	28	29	30	1	2	3	4
19	5	6	7	8	9	10	11

Unset >

Select Time:

11:00 ▾

Select Station:

Coventry University Station ▾

Arduino AT MEGA board

UNICAS Lab (new link) 🔗

book



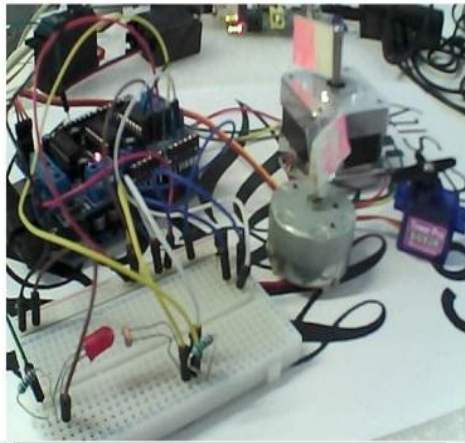
Web View



Web browser address bar: clem.coventry.ac.uk/arduino/remote_lab.php

Navigation menu: CCloud services for E-learning in Mechatronics | Home | Board Configuration | Remote Testing | Schedule | About Us | Hi an75824

Streaming from: Coventry University Station



Example Source code: Examples

Or input your own source code:

```
1
2
3 /*
4  * Blink
5  * Turns on an LED on for one second, then o
6  *
7  * This example code is in the public domain
8  * */
9
10 // Pin 13 has an LED connected on most Ardu
11 // give it a name:
12 int led = 13;
13
14 // the setup routine runs once when you pre
15 void setup() {
16
```

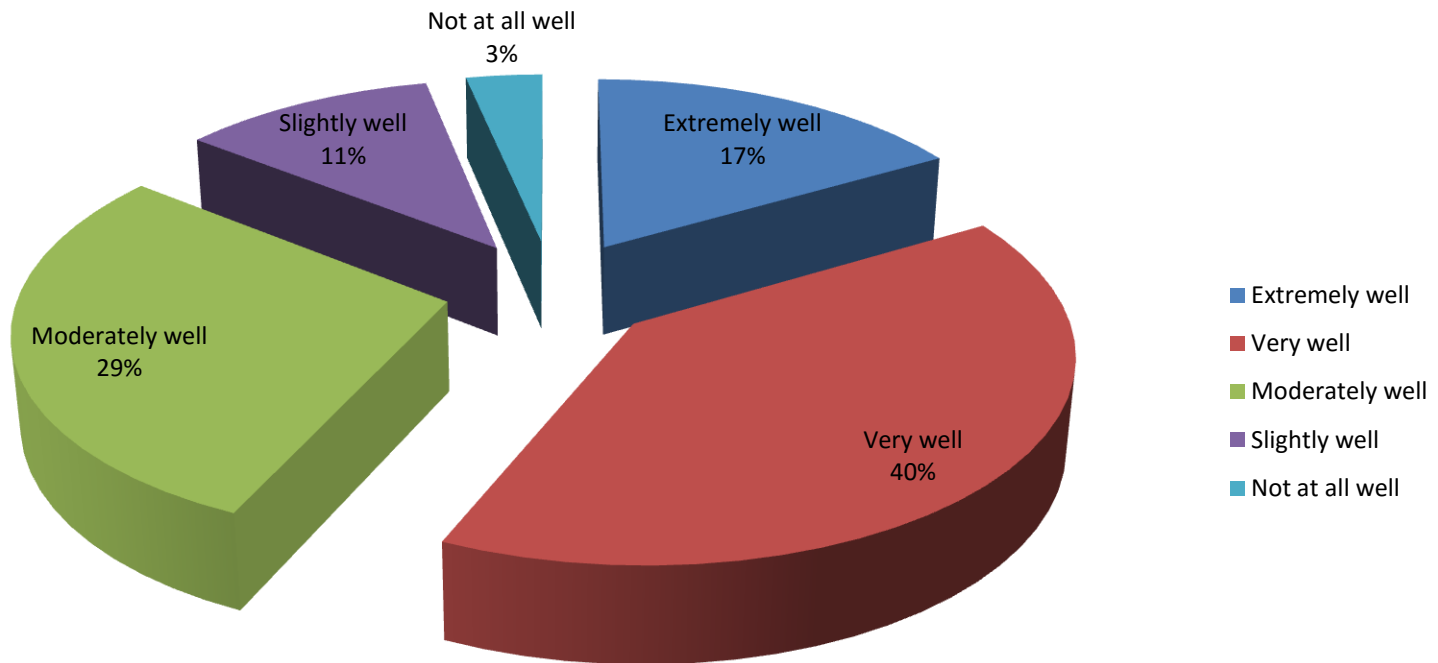
Operations:

- Compile ✓
- Upload ↗
- Reset ✕
- Actions ▾

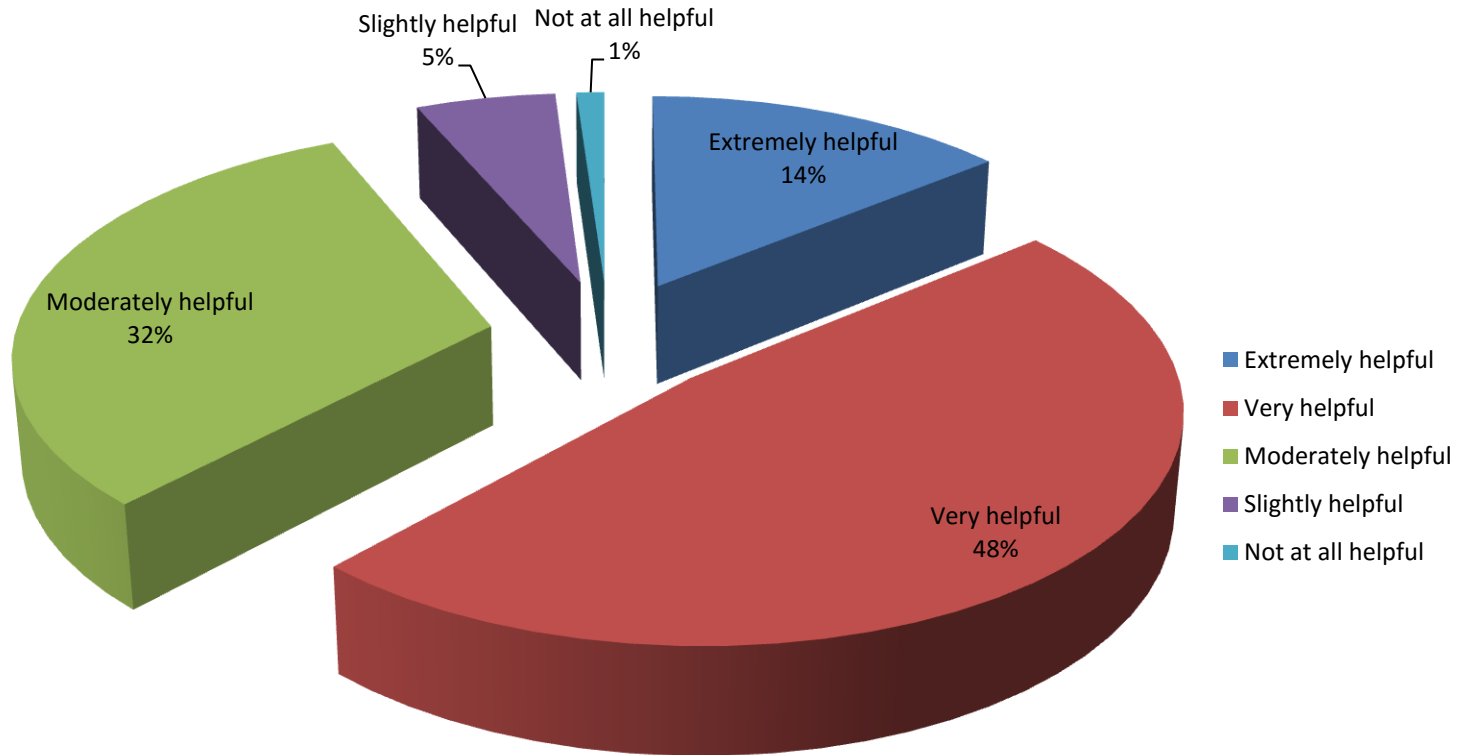
Results:

"How well would the tool you have seen contribute to meeting the learning needs of your students?"

Question 5

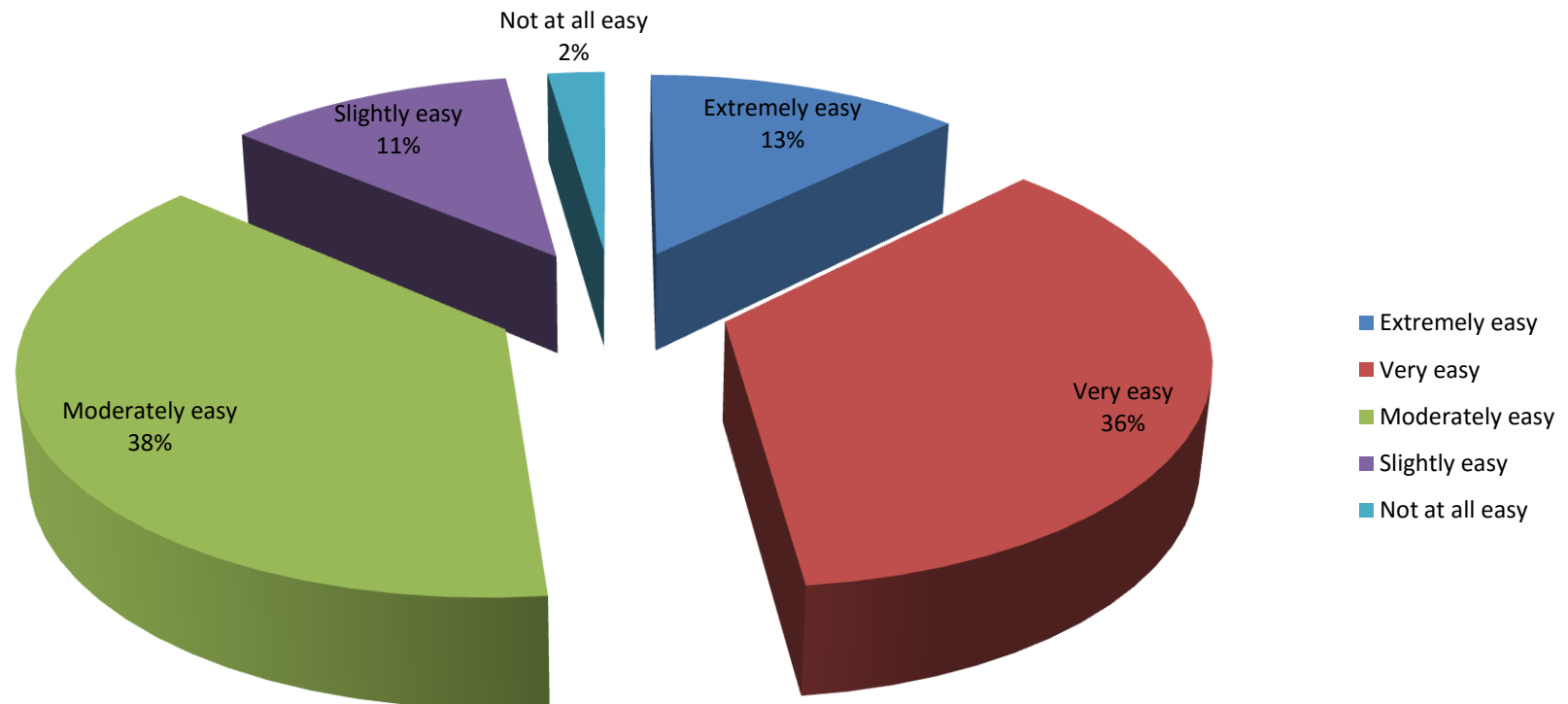


"How helpful is the tool?"



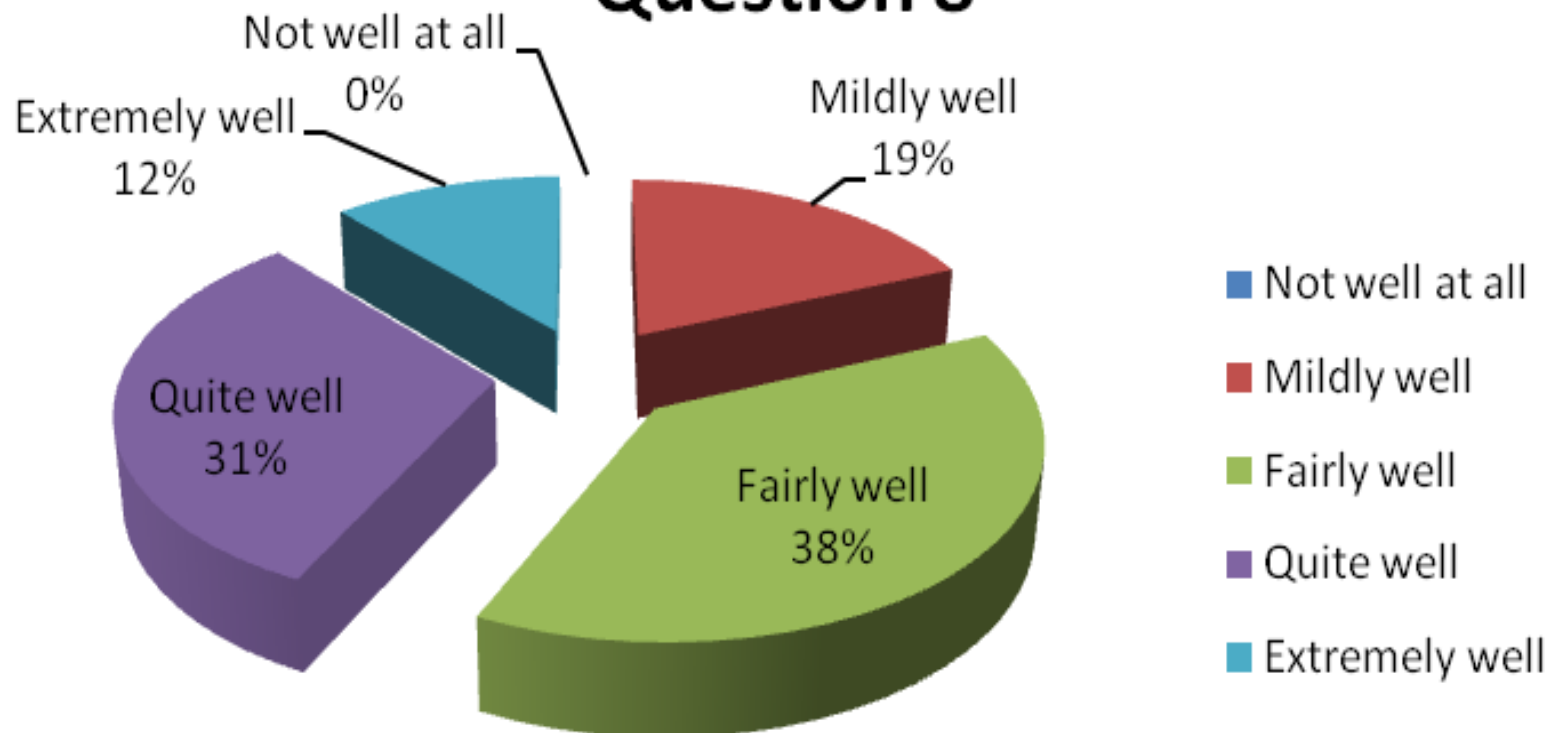
How easy is the tool to use

Question 7

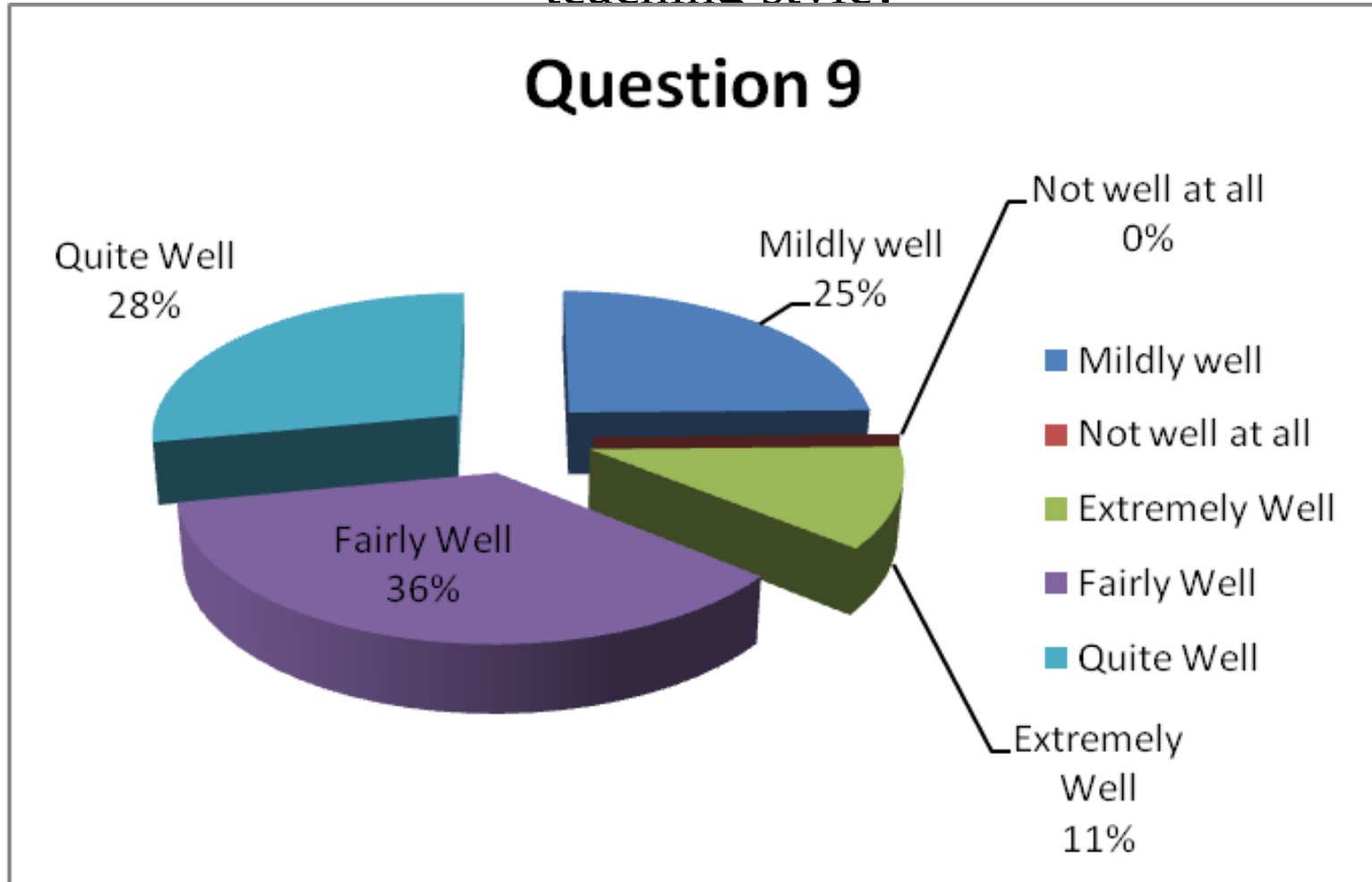


How well do the activities offered from this project match your student's interests?"

Question 8



How well does the cloud computing learning/teaching style match your learning or teaching style?"



Conclusion



- A cloud-based ecosystem for e-learning, resource-sharing and support for mechatronic vocational education teachers and learners.
- CLEM allowing large number of distributed mechatronic devices to become sharable and to be used for e-learning.
- The platform enabling isolated resources such as CNC machines, 3D printers, and stepper motors to be linked to electronic learning materials, administered through the cloud and consumed by the users remotely.
- The learners, teachers and trainers can book these resources through a scheduling system and access them via a web interface.
- CLEM, a proprietary platform, specially tailored to gather heterogeneous and distributed mechatronic devices in a common pool.