Exploitation Plan for

Problem-based Learning Laboratory

(Centralized Visualization System Laboratory)

Institute of Engineering, Tribhuvan University

Contents

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1. Introduction

The Central Visualization Systems Laboratory namely Problem Based Lab was established in Institute of Engineering, Tribhuvan University under the Active Learning in Engineering (ALIEN) project funded by the Erasmus+ implemented in the period 2017-2020. The project had provision of funding to establish an active learning laboratory which is in total of Euro 18500. This funding was used to buy and establish the laboratory. This laboratory was established in the premises of Centre for Energy Studies (CES), Zero Energy House, Pulchowk Campus complex. The facilities will be used by the faculty, researchers and students of Tribhuvan University. Among the facilities of the laboratory, equipment and accessories were procured under the ALIEN project whereas other facilities were provided by the Centre for Energy Studies, Institute of Engineering, Tribhuvan University. It is in-line with a futuristic learning space. For sustainability of use of the lab, a sustainable plan has been developed.

2. Purpose of the lab

The main purpose of the lab is to develop students' practical and transferable skills, as well as their content knowledge and scientific understanding, and also to address the concern expressed in the literature over the effectiveness of the traditional laboratory courses to achieve these objectives.

It is expected to provide students with the opportunity to develop skills related to:

- Working in groups.
- Leadership development and holding leadership roles.
- Better communication, both oral and written.
- Self-awareness.
- Working independently.
- Critical thinking and analysis.
- Applying course content to practical field.
- Researching and information literacy.
- Problem solving across disciplines.

It is expected the Central Visualization facilities will encourage students to prepare for their laboratory sessions in an active and collaborative manner through pre-lab exercises. By combining elements of group work, group discussion, practical hands-on activities, and various alternative assessment methods the students will be provided with an environment conducive to meaningful, deep learning.

The following picture is the organizational chart of the Institute of Engineering, Tribhuvan University.

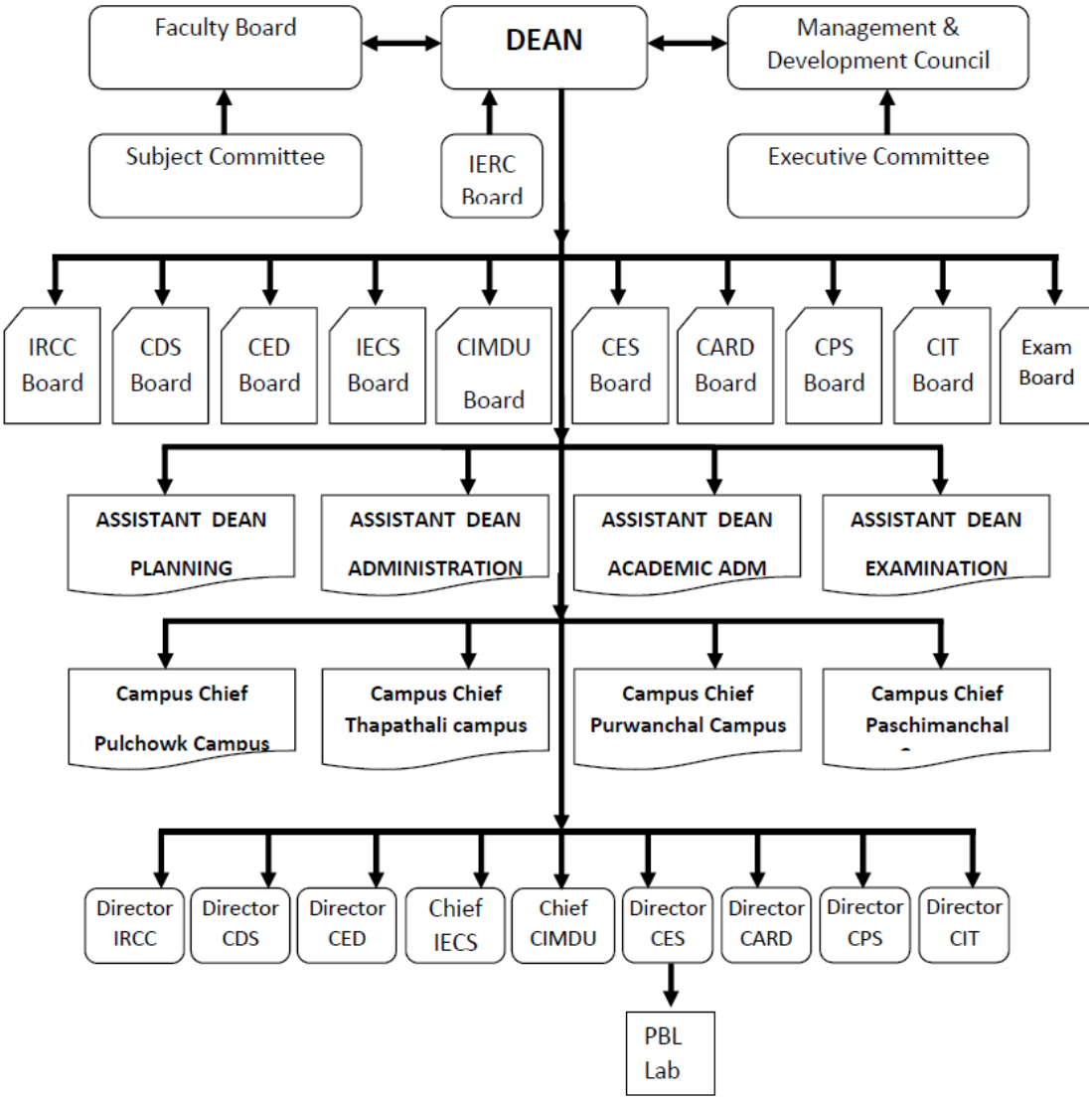

Figure 1. The ALIEN problem-based learning lab is part of the Centre for Energy Studies in the Organogram of Tribhuvan University.

3. Guidelines for use of the lab facilities

This facility is designed as a multipurpose working space for supporting the teaching and learning process towards solving real problems in engineering disciplines. Problem-based learning activities were developed by adapting existing student experiences rather than changing the already deployed experiments. Specific engineering problems are assigned to students with a focus on pre-laboratory exercises, associated group work, and assessment methods as well as on actual practical work. Mainly, the laboratory is designed as a multipurpose lab for:

- Conducting collaborative active learning classes and sessions.
- Delivering and providing training to institutions and individuals outside of the university.
- Designing and developing ideas of innovative products.

3.1 Process

In order to ensure smooth running of the facilities, user guidelines have been developed. The process is identified below:

- The faculty members of the Institute of Engineering, Tribhuvan University can use the facility of the Central Visualization Laboratory for problem-based learning activities. Prior to using the laboratory they should inform the administration of the Centre for Energy Studies (CES) for scheduling.
- The departments or specific programs of the university can use the facilities on a regular basis by allocating time in their class routine. Any planned used of the laboratory should be communicated to the administration of the Centre of Energy Studies at the beginning of each semester.
- Students who wish to work on projects, implement ideas, or solve problems in this facility can request access by contacting the administration.
- This facility will also be made available to individuals or institutions in specific timeslots. Parties interested to use the laboratory facility must submit an application in advance. They will be charged as per the rules of the university.

4. Activities and courses implemented in the lab

The Centralized Visualization System Laboratory under ALIEN project has been used in diverse academic and community contexts. The laboratory has already been used in selected courses offered by the

Department of Electronics and Computer Engineering. There is a lot of potential for using the laboratory facility in other disciplines such as Operation Research and Management Science, Multi-Criteria Design Analysis, and more.

To facilitate the smooth use of the facility, 2 training sessions have been organized in 2 different subjects:

- Central Visualization System Laboratory support, maintenance, and troubleshooting.
- Central Visualization System Laboratory for active learning operation.

The trainings were attended by instructors and staff from different departments of the university who are involved actively in teaching and learning process through problem-based learning methodologies.

4.1 Methods and Facilities use

The laboratory will be used regularly in courses such as:

- Course title: Operation Research and Management Science.
  The course is a 1st year elective in the curriculum of the M.Sc. in Engineering in Energy Systems Planning and Management (MSESPM) of the Department of Mechanical Engineering.
- Course title: Image Processing.
  The course is a 2nd semester elective course offered in the M.Sc. in Computer Systems and Knowledge Engineering program of the Department of Electronics and Computer Engineering, Pulchowk Campus, IOE, Tribhuvan University.
- Course title: Knowledge Engineering.
  This is a 1st xemester introductory core course offered in the M.Sc. in Computer Systems and Knowledge Engineering program of the Department of Electronics and Computer Engineering, Pulchowk Campus, IOE, Tribhuvan University.
- Course title: Social Computing.
  This is an elective course offered in IT related M.Sc. programs of IOE, Tribhuvan University.
- Course title: Information Visualization.
  This is a 2nd semester core course offered in the M.Sc. in Computer Engineering Specialization in Data Science and Analytics program of the Department of Electronics and Computer Engineering, Pulchowk Campus, IOE, Tribhuvan University.

- Problem-based learning methods will also be applied in Robotics Clubs, such as the ROBOCON International and National Competition, which is hosted in the Pulchowk Campus of the Institute of Engineering, Tribhuvan University.
- The facility will also be used for the activities of the Laboratory for ICT Research and Development (LICT).
- Problem-based learning will be regularly deployed for pilot studies on the upgrading of the university examination system by the Examination Control Division.
- The facility will also be used for mutual benefit for members of Nepal Engineers' Association as a result of the MoU that was signed between Tribhuvan University and the association.

5. Available resources

5.1 Software

The software installed in the Central Visualization Laboratory at the Centre for Energy Studies, Institute of Engineering is VizExperts. It is developed by VizExperts India Pvt Ltd, L-320, 1st Floor, Lane No 9, Mahipalpur Extension, New Delhi, Delhi, India - 110037. Phone : (+91) 11 2678 1491 Fax : (+91) 124 4116643.

The purpose of the software is to provide innovative and easy-to-use software for high end visualization systems, such as:

- High end 2D and 3D visualization.
- Ultra high resolutions.
- Visualization of high volumes of data.
- Visualization of input in different forms, such as video, audio, and text.

5.1.1 Key software features

- Functionality to hot-plug a video source.
- Seamless large display as a combination of single displays of resolution up to 6960 X 2160.
- High resolution full-HD video grabbing.
- Video sources support: VGA, DVI, HDMI, SDI, BNC, S-video, Composite Video, and TV Tuner.
- Support for networked streamed video sources.
- Support for audio.

- Complete control of an entire display wall through a controller application running on a multi-touch table or iPad.
- Preview and control of video sources: resizing, movement, transparency, and refreshing.

The following figure shows high level software and hardware modules in the application.

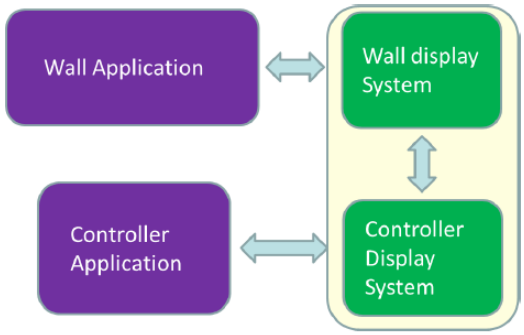

Figure 2. High level software and hardware modules offered by VizExperts.

5.2 System architecture

The hardware system offers the following additional features:

- The administrator can decide whether to display a single video source or all the video sources to the Central Visualization System.
- The media server and central visualization system are connected; the video sources are selected using the IP addresses of the machine.
- The administrator has full privilege to customize the display themes, size of the display, and settings.
- Video sources support: VGA, DVI, HDMI, SDI, BNC, S-video, Composite Video, and TV Tuner.
- Support for networked streamed video sources.
- Support for audio.
- Complete control of an entire display wall through a controller application running on a multi-touch table or iPad.
- Preview and control of video sources: resizing, movement, transparency, and refreshing.

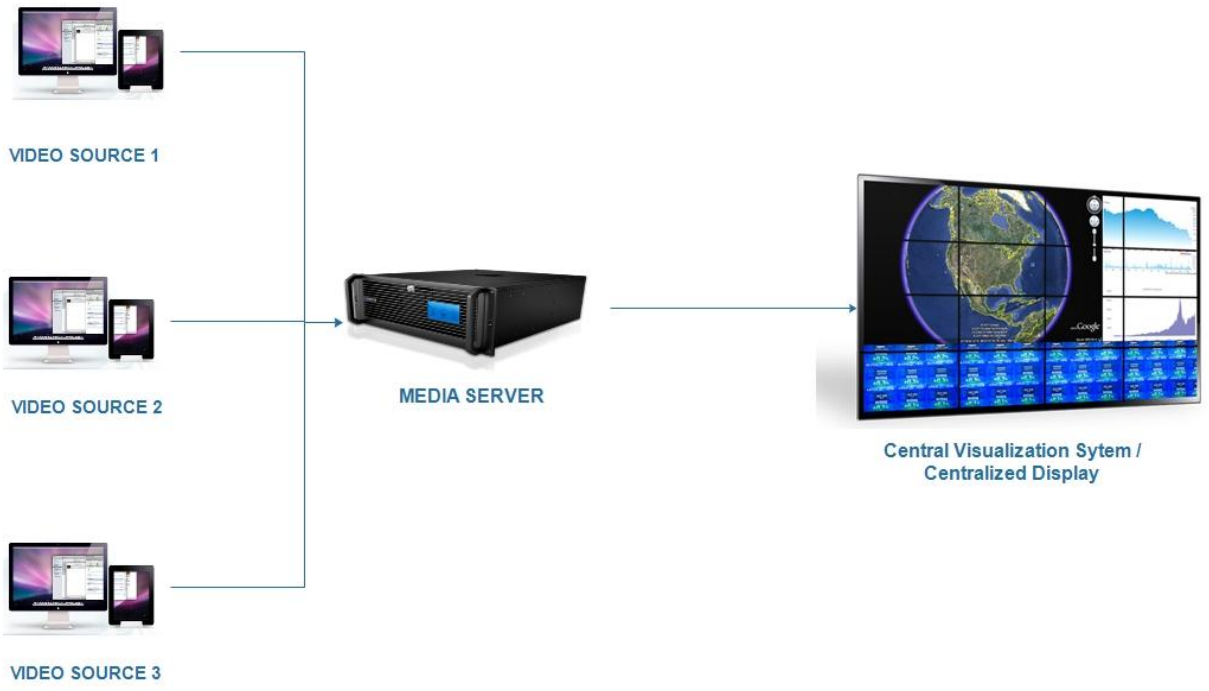

Figure 3. The hardware architecture of the Central Visualization Laboratory.

5.3 Definition of terms used

- Video Source.

  Every single video data fed to the system, be it pc output, DVD player output, camera output or TV input is called a Video Source.

- Wall.

  Wall is the area on which all input video sources will be displayed. This could be a single desktop monitor, a dual monitor computer display, a video wall of various display cubes, or a large, seamless, multichannel edge blended projection wall. The display surface may be curved or flat.

- Controller.

  Controller is the system controlling and managing all video sources. This includes tasks such as dynamically identifying the video sources to be displayed on the wall, the display position on the wall, and their size. This system may be a Multi Touch Table, PC, laptop or iPad.

- Session.

  A session starts when the wall and the controller are connected and the controller can be used to modify, add, or remove video sources on the wall. A session supports the loading of layouts and presets.

- Layout.

  A layout is a template defining the video sources, their position, and their size in relation to the wall. This template can be configured and saved so that a particular session can be loaded quickly as per the needs of a given situation. Saving a layout allows retrieving the look and feel of a particular session.

5.4 Operating environment

The operating environment specifications for the software are as follows:

- Thermal conditions.

  The recommended operating environment is a room temperature of 18° C to 22° C with humidity level below 40 %. Non condensing humidity levels should be always maintained.

- Controller configuration.

  The software and hardware requirements for the controller are displayed in the following table.

Component	**Operating System**	**Processor**	**Graphics card**	**RAM**
Requirement	Windows 8.1 64-bit, iOS 8.1 (For iPad Controller)	Intel, AMD (preferably multi-core)	NVIDIA (8xxx series or higher), AMD (HD 4xxx series or higher)	Recommended 4 GB

Table 1. Controller software and hardware configuration requirements.

- Wall configuration.

  The wall software and hardware configuration requirements are displayed in the following table.

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RAM	Recommended 4 GB

Table 2. Display wall hardware and software configuration requirements.

6. Sustainable operation and maintenance

The operation and maintenance of this lab is performed by the Centre for Energy Studies. The Centre for Energy Studies will coordinate with the Dean's Office and campuses of the Institute of Engineering for the year round operation of the facilities. Required support staff will be provided by the university. Supporting facilities exist on the university premises. The scheduling of the laboratory facility will be managed by the Tribhuvan University departments and the laboratory coordinator. The maintenance of hardware and software will be carried out in cooperation with the campus maintenance unit. Maintenance of the website will be assigned to a web developer and administrators. The operation and maintenance budget of the facilities will be allocated from internal resource generation and it will be included in annual budget of the Centre for Energy Studies.