Exploitation plan for

problem-based learning laboratory

University of Malaya

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# 1. Name of the lab

The name of the lab is Technology Enabled Learning Space (TEALS). TEALS was established under the Active Learning in Engineering (ALIEN) Project funded by the Erasmus+ implemented in the period 2017-2020. The project gave funding to establish an active learning laboratory. The funding was in total Euro 18 500 equivalent to around RM 85 000. This funding was used to buy equipment such as movable workstations, programmable drones, autonomous cars, 3D printer, Raspberry Pi, Arduino, and writable surfaces. The equipment belongs to the University of Malaya after the project ends in April 2021 and does not belong to the individual grant holder.

The furniture of TEAL, however, was provided by the faculty. It is in-line with a futuristic learning space. At the end of the project, a sustainable plan of action is required to be established in all the partnering universities of the ALIEN project including the one in University Malaya under the Software Engineering department. Refer to Attachment 1 on the current design of TEALS done under the ALIEN project.

## 2. Faculty in which the lab belongs

TEALS is located at the Faculty of Computer Science and Information Technology (FCSIT), University of Malaya.

**FCSIT facilities**

**Teaching and learning**

Theatre Room
CCNA Lab
Micro Lab 1
Micro Lab 2
Micro Lab 3
Stroustrup Lab
IOS Lab
Theatre Hall 1
Theatre Hall 2
Tutorial Room
Lecture Room 1
**Lecture Room 2 (TEALS)**

**General purpose**

The Cube
IDEA Lab
Student Centre
Staff Lounge
Postgraduate Lounge

**Research**

**SE Department**
- Software Engineering Lab
- HCI Lab
- Software Engineering Process Lab
- I-Interact Lab
- Multi modal Lab
- Empirical Lab
- Software Req, Architecture, and Reuse Engineering

**Network Department**
- Computer Technology
- Computer Systems & Network
- VLSI
- Stroustrup 2
- Network Analytics
- Mobile Ad-hoc Technology
- Mobile Cloud Computing

**Information Systems Department**
- Information Science
- Information System
- Data Science
- Infometrics
- Web Based Information Systems

**Artificial Intelligence**
- Artificial Intelligence
- Cognitive Science
- Advanced Robotic
- Knowledge Engineering
- AIED / ES / NLP / Intelligent System

**Multimedia Unit**
- Multimedia
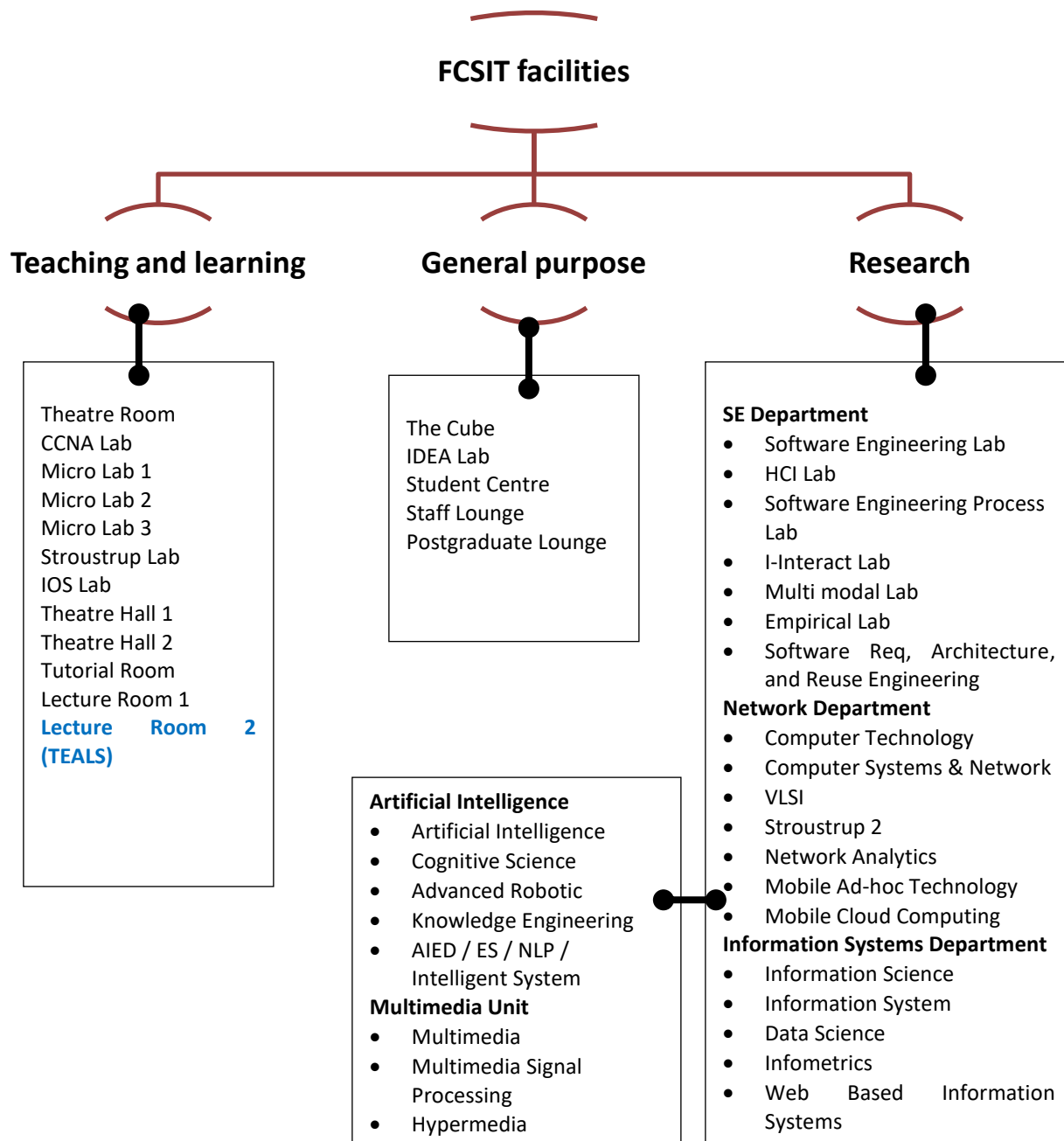- Multimedia Signal Processing
- Hypermedia

**Figure 1. University of Malaya organogram, demonstrating the TEALS lab.**

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# 3. Purpose of the lab

The purpose of the lab is to instill innovative skills in context of cognitive, psychomotor, and affective to FCSIT students and the general public to ignite the potential of students for futuristic skills needed to drive the Malaysian economy to a greater height.

Therefore, it is the purpose of this paper to outline a feasible sustainable model for TEALS that can be used to generate income to the department specifically and generally to the faculty. It is the intention to align this sustainable goal to the concept of Maker's Lab.

TEALS is a learning space designed under the ALIEN Erasmus+ project for conducting active learning classes in the Software Engineering Department, Faculty of Computer Science and Information Technology, University of Malaya. The aim of creating the learning space is to equip software engineering students specifically or computer science students in general for the workplace to solve future problems and to improve the psychomotor, cognitive, and affective skills in teaching and learning software engineering courses. To achieve this aim, hardware and software are used in the active learning process to strike a good balance between emphasizing knowledge and application of the knowledge.

## 4. Guidelines for use of the lab

TEALS is designed as a multipurpose lab for:

I. Conducting collaborative active learning classes and sessions.

II. Delivering training session to individuals outside of the faculty and University of Malaya.

III. Designing and developing ideas of innovative products.

In order to use the TEALS lab, individuals need to follow the process identified below:

I. Any lecturer in the Faculty of Computer Science and Information Technology could request to conduct classes in TEALS. Every semester, the faculty's time-table committee assigns a random course to be conducted in TEALS. Special request could be made to conduct classes in TEALS so that the lecturer involved will be able to use TEALS equipment to conduct active learning.

II. Students and lecturers from the faculty could also book to use TEALS for any event through the e-booking system of Faculty of Computer Science and information. http://eroom.fsktm.um.edu.my/Web/?

III. Interested persons outside of the faculty would have to write a letter to the Deputy Dean of Research and Development and send the request to rent the usage of TEALS. The letter should be emailed to tdp_fsktm@um.edu.my. The contact numbers are as follows:

Tel: +603 7967 6305
Fax: +603 7957 9249

IV. Cost of usage and target users
The following guidelines apply:

| No | | |
|---|---|---|
| 1. | Software engineering students <br><br> • At least 3 subjects for each semester | Up to 100 students |
| 2. | Students from other departments <br><br> • At least 1 subject for each semester | Up to 50 students |
| 3. | The general public <br><br> • At least 2 events per year | Up to 50 participants |
| | TOTAL target users per year | At least 200 individuals using the lab |

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**Table 1. Target users of the TEALS Lab.**

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## 4.1 Software and hardware availability and price for rental

For example: Package with training through workshop, one day training, play time with drones, and others.

## 4.2 Rental Sservices

| No | Equipment | Quantity/ unit | Price/ RM |
|---|---|---|---|
| 1. | Workstation (7 islands) <br><br> • Wireless keyboard and mouse | 7 | 500 |
| 2. | Drones | 5 | + 100 per unit |
| 3. | Arduino | 7 | + 10 per unit |
| 4. | Raspberry Pi | 7 | + 100 per unit |

| 5. | Autonomous car | 7 | + 100 per unit |
|----|----------------|---|----------------|
| 6. | 3 D Printer<br><br>• With colorful filament<br>• Blue, red, green, white | 1 | + 50 per print depending on how big the object |
| 7. | Multiple types of Sensors, LED light and wires | Many | + RM10 per package |
| 8. | Galaxy Tablet | 1 | 50 |

**Table 2. Equipment available for rental in the TEALS lab (price rate may vary and usage may be free of charge or with discount for educational, charitable non-profit events).**

# 5. The following is an example of the use of TEALS

## 5.1 Course description

Course Human Computer Interaction (WIF2001) is part of the Software Engineering curriculum. The course covers both human factors and technical methods for the design and evaluation of interactive systems. The course is structured along 4 main topics: overview of human computer interaction (HCI), essential interaction design principles, user interface development process, and interface design and programming.

Overview of human computer interaction introduces humans, computers, and interactions; user interfaces (UI); usability and user experience (UX).

Essential interaction design principles include topics on psychopathology of everyday things, psychology of everyday actions, knowledge in the head and in the world, knowing what to do, understanding and designing for error.

User interface development process includes topics on iterative design, user-centered design, design discovery, design exploration and evaluation of user interfaces.

Interface design and programming includes topics on visual information design, forms design, interface design patterns, prototyping and construction tools, and responsiveness issues.

Three types of applications are covered: graphical user interfaces, the web, and mobile devices.

The number of students engaged in 2020 was 159.

## 5.2 PBL activities in the course

This scenario describes the active learning conducted in the Human Computer Interaction course and the Mobility Program.

In the 2020 session of the course, a project was assigned to students, who were challenged to implement it through active learning, specifically project-based learning with the intention to

cover the following topics: design principles, conceptual design method, storyboarding, personas, and usability testing. The context of application of these topics is embedded in the following objectives of the project:

- To design, prototype and evaluate an interactive game.
- To apply the knowledge and content of the HCI course in real-life situations using Arduino/Raspberry Pi, 3D printer, and writable surfaces.

The project website is available at http://alien.fsktm.um.edu.my, which illustrates the use of TEALS, the equipment, and the outcomes of the project, namely:

- The conceptual design.
- The game prototypes.
- The persona.
- The usability evaluation.

## 5.3 Educational material (books, scenarios, etc. and sources)

The following educational material is used. It is downloadable from the Internet.

### 5.3.1 Active learning – project-based

Two examples of research papers referred to during the course are by Sedelmaier & Landes (2015) and Sibona, Pourreza, & Hill (2018).

The full bibliography information is as follows:

Sedelmaier, Y., & Landes, D. (2015). Active and Inductive Learning in Software Engineering Education. 2015 IEEE/ACM 37th IEEE International Conference on Software Engineering. 5, pp. 418-427. IEEE. doi:10.1109/ICSE.2015.174

Sibona, C., Pourreza, S., & Hill, S. (2018). Origami: An Active Learning Exercise for Scrum Project Management.: EBSCOhost. Journal of Information Systems Education, 29(2), 105-116.

### 5.3.2 HCI project description

https://drive.google.com/file/d/1DqoscHXtWMtpN4qN5BPnPyWafu9eX4OV/view?u sp=sharing.

### 5.3.3 Raspberry Pi reference - what is inside the starter kit

https://www.dexterindustries.com/product/grovepi-starter-kit-2/.

Port Description https://www.youtube.com/watch?v=gbJB3387xUw

https://www.dexterindustries.com/GrovePi/engineering/port-description/

Some Projects: https://projects.raspberrypi.org/en/

### 5.3.4 Arduino reference - getting started

https://www.youtube.com/watch?v=64oEr1zTlOg.

Downloads (Arduino IDE) and resources:

https://www.arduino.cc/.

https://create.arduino.cc/.

# 6. Activities and courses implemented in the lab

The list of courses that used TEALS and conducted active learning sessions with the specialized equipment from Semester 2, 2018/2019 to Semester 2, 2020/2021 is as follows:

- Human Computer Interaction (HCI).
- Software Modeling, Control Flow Mobility Program.
- Real Time Programming, Agile software development.
- Design and Analysis of Algorithms.
- Advanced Algorithms, Software Testing.
- Project Management.
- Final Year Project.

Other courses were also conducted in the TEALS lab using only the collaborative setup with one workstation per island. TEALS is a common teaching and learning space in the faculty. In addition to collaborative work, the lab is also used for normal lectures or presentations. The lab is included in the time-table as one of the rooms in which lectures are conducted. The time-table committee may assign the room to a random course as long as the number of students does not exceed the capacity of 49 students.

One of the plans in relation to the usage of TEALS is to make it a specialized lab to conduct any course in the Faculty of Computer Science and Information Technology in line with the University and Government policy. Research equipment from expired research projects held by specific lecturers can be put in TEALS to be used in teaching and learning. Consequently, TEALS may provide other equipment then listed in the equipment section. The courses listed at the beginning of this section are the most likely subjects to use TEALS. The courses are part of the Software Engineering curriculum. Other courses from other departments are also likely to deploy TEALS. Examples of other departments that may use the lab include:

- Artificial Intelligence Department.

- Networking and Computer Systems Department.

- Information Systems Department.

- The Multimedia Unit.

# 7. Resources

The following resources are available in the TEALS lab.

## 7.1 Equipment

The following table demonstrates the equipment available in TEALS.

| Equipment | Features | | | Brief description |
|---|---|---|---|---|
| Workstation | 8th GenerationIntel® Core™i5-8400 Processor<br><br>Windows 10 Home 64bit | 8GB DDR 4 2666MHz<br><br>16GB Inte l®Optane™ memory accelerated 1TB 7200 RPMHDD | Premier Wireless Keyboardand Mouse | One workstationper island |

| 32" LED Monitor Display | with HDMI Cable  Portable Stand for LED TV Display  Moveable stand with  Adjustable shelf height for storage space | Integrated cable management system  Heavy gauge columns constructed  Resolution 1366 x 768 | HDMI/USB /Compone nt In (Y/Pb/Pr)/ Composite In (AV) Connectivity  Slim Type  LED Type  Wide Color Enhance  Slim edge Mold Design | One monitor perisland |
|---|---|---|---|---|
| Heavy-duty casters | Max load capacity: 46 kg  Power Extension Socket Tower Type-2-Tier | With reinforced design support the equipment weight while allowing for swift maneuverability | | |
| Computer | Professional HDMI Cable 2M | | | |

| Peripherals | Asus RT-AC58U AC1300 Dual-Band Gigabit Wireless Router | |
|---|---|---|

| | | |
|---|---|---|
| Drones | Programmable Drones with accessories | To support programmable hardware projects, which can be related t o software engineering and the Internet of Things (IOT), Machine Learning, and CloudComputing |
| Raspberry Pi | Raspberry Pi Learning Kit come with user module training/manual | |
| Arduino | Arduino Learning & Development Kit (complete sensors/modules) | |
| Autonomous car | Smart Video Car Kit for Raspberry Pi Compatible with RPi 3, 2 and RPi 1 Model B+ | |
| 3D Printer | With extra filaments | To facilitate analysis, design, development, andevaluation stagesof software development |
| Samsung Galaxy Tab A | A with S-Pen come with Miracast device | For teachers to control lecture materials in an active learning environment |

| Writable surface | Materials: Acrylic Glass  -Background: Avery White | -Size & Thickness: 90 cm x 60 cm x 5 mm | To support brainstorming and discussion sessions with sketches and diagrams to facilitate active learning |
| --- | --- | --- | --- |

*Table 3. TEALS equipment.*

## 7.2 Software

The following software are being used and they are downloadable from the Internet

- Arduino IDE.
- Raspberry Pi OS with all peripherals.
  - Python editor.
- Software for wireless connection to wireless projector.
- 3D Studio to print 3D object.

# 8. Staffing

The maintainability of the equipment is proposed to be under:

- Technician working in the FCSIT.
- SE department specific technician.
- SE department coordinator lecturer (TEALS Maker's Lab coordinator).
- FSKTM-Technovation.

The above staff is already employed by the university.

Maintenance of the website is to be assigned to a web developer and administrators. Below is a list of student project based on classes using TEALS. This project information can serve as an advertisement to display completed projects implemented in TEALS.

- http://alien.fsktm.um.edu.my/
- http://alien.fsktm.um.edu.my/woa7001/group1/group1.html
- http://alien.fsktm.um.edu.my/woa7001/group2/
- http://alien.fsktm.um.edu.my/sem1_2020/group3/g3.html

# 9. Financial support

Financial support from the University of Malaya will be needed to maintain the lab. Essential needs to maintain the usage of the equipment would be:

- The battery for the wireless mouse and keyboard.
- The refill of the 3D printer.
- The replacement of broken Arduino and RaspberryPi and sensors.

It is also possible to buy these through other research funding related to teaching and learning.

The ALIEN equipment bought for TEALS will be maintained as University of Malaya equipment and devices.