FKEPG-LIMS : Fakulti Kejuruteraan Elektrik Kampus Pasir Gudang Lab Inventory Management System

Farah Yasmin Abdul Rahman[1*], Nurhani Kasuan[2], Ezril Hisham Mat Saat[2], Noor Hasliza Abdul Rahman[2], Nur Iqtiyani Ilham[2], Siti Noor Suhana Jamil[3]

[1]*Fakulti Kejuruteraan Elektrik, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia*
[2]*Fakulti Kejuruteraan Elektrik, UiTM Cawangan Johor Kampus Pasir Gudang, Masai, Johor, Malaysia*
[3]*School of Computing, Faculty of Engineering, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia*
*Corresponding author E-mail:farahy@salam.uitm.edu.my

Abstract

Information are the most valuable commodity in the modern era. In today's lifestyle, society are virtually swarmed with a lot of information that cannot be misplaced or vanished. This study presents a development of web-based lab inventory management system that is used to record, manage and retrieve the lab equipment and components in Fakulti Kejuruteraan Elektrik Kampus Pasir Gudang namely FKEPG-LIMS. The main purpose of this study is to assist faculty members to view and keep track all the available lab equipment that have been purchased. The users can be classified as the Faculty Head, lab technicians, lecturers and students. The database is developed using MySQL and the HTML script written in PHP and Adobe Dreamweaver used design the web interface. The research has successfully demonstrated the feasibility of FKEPG-LIMS in managing and storing all the information. The stored information can also be retrieved, edited and deleted. The developed lab inventory management system will benefits users by providing fast and precise solution in inventory management.

Keywords: *Database; Llab equipment inventory; Website.*

1. Introduction

Information are the most valuable commodity in the modern world. It may source in many different forms such as staff and student information, scientific and statistical data, graphics or even multimedia files. The society today are virtually swarmed with lots of information and they cannot afford to lose it. Conventional data keeper such as file cabinets or boxes are no longer suitable to store all this information.

Database is a collection of secured information that is organized so that it can be accessed by multiple user in different angles, managed and updated easily when necessary. It is stored is rows, columns and tables, and it is indexed to make it easier to find relevant information. Data gets updated, expanded and deleted as new information is added. Usually there will be a person or group people called administrator with ability to control and manage the database contents as well as user accessibility.

Web server is a tool in a form of software or hardware. It can be used to store the contents and data of any website. In terms of hardware, a server consists of computer will stores the web server software and the website's component files i.e.: HTML documents, images, CSS stylesheets and JavaScript files. Meanwhile for software, the server consists of protocols on way to control the data accessibility. The software must be able to understand the URLs (web addresses) and protocols to view the webpages [3]. This research presents the development of Lab Inventory Management System (LIMS) for managing the lab equipment in Fakulti Kejuruteraan Elektrik Kampus Pasir Gudang which called as FKEPG-LIMS. The system is developed using MySQL for the database, Apache for the HTML server, PHP for the language to build the webserver and Adobe Dreamweaver to build the website's user interface.

2. Related Studies

There are many studies developed a database for to manage their inventory and data. Hashim and Ariffin [4] developed Laboratory Inventory System for labs in Faculty of Electronic and Computer Engineering Universiti Teknikal Melaka Malaysia. Their database was built using Microsoft SQL. They used Hypertext Processor (PHP) and Adobe Dreamweaver S3 to build website as GUI to the database. Hardono et al [5] developed a Theses Categorization System Search Engine using PHP and MySQL. They used the system to search and retrieve thesis and dissertation of Universitas Indonesia published between 2005 until 2015.

Chandra et al [6] presented their study on Global Positioning System (GPS) mobile phones application. The application on mobile phone developed using J2ME and the server is built using MySQL and PHP. Nielsen et al [7] presented their study on an open-source data storage and visualization and back end for experiment data. MySQL is used for the database, Phyton, PHP and HTML/CCS are used to extract the data from the database and show the data on a web page.

Based on the reviews on [4-7], it can be concluded that the researchers used MySQL and PHP to develop their lab equipment database because it is open-source, simple and easy to use [8]. Meanwhile, various type of software being used build the content management system (CMS). For this study we proposed to use XAMPP that bundled PHP and MySQL together to build the web server and Adobe Dreamweaver to build the website.

3. Methodology

The methodology of system developed is based on framework that is used to structure, plan, and control the process of information system. Usage and management FKEPG-LIMS can be access users from desktop platform. Fig. 1 shows the overall Use case diagram that describes the proposed system's functionality. It represents the interaction between actors and system. The Use case model will express actor's roles in the system in form of diagram.
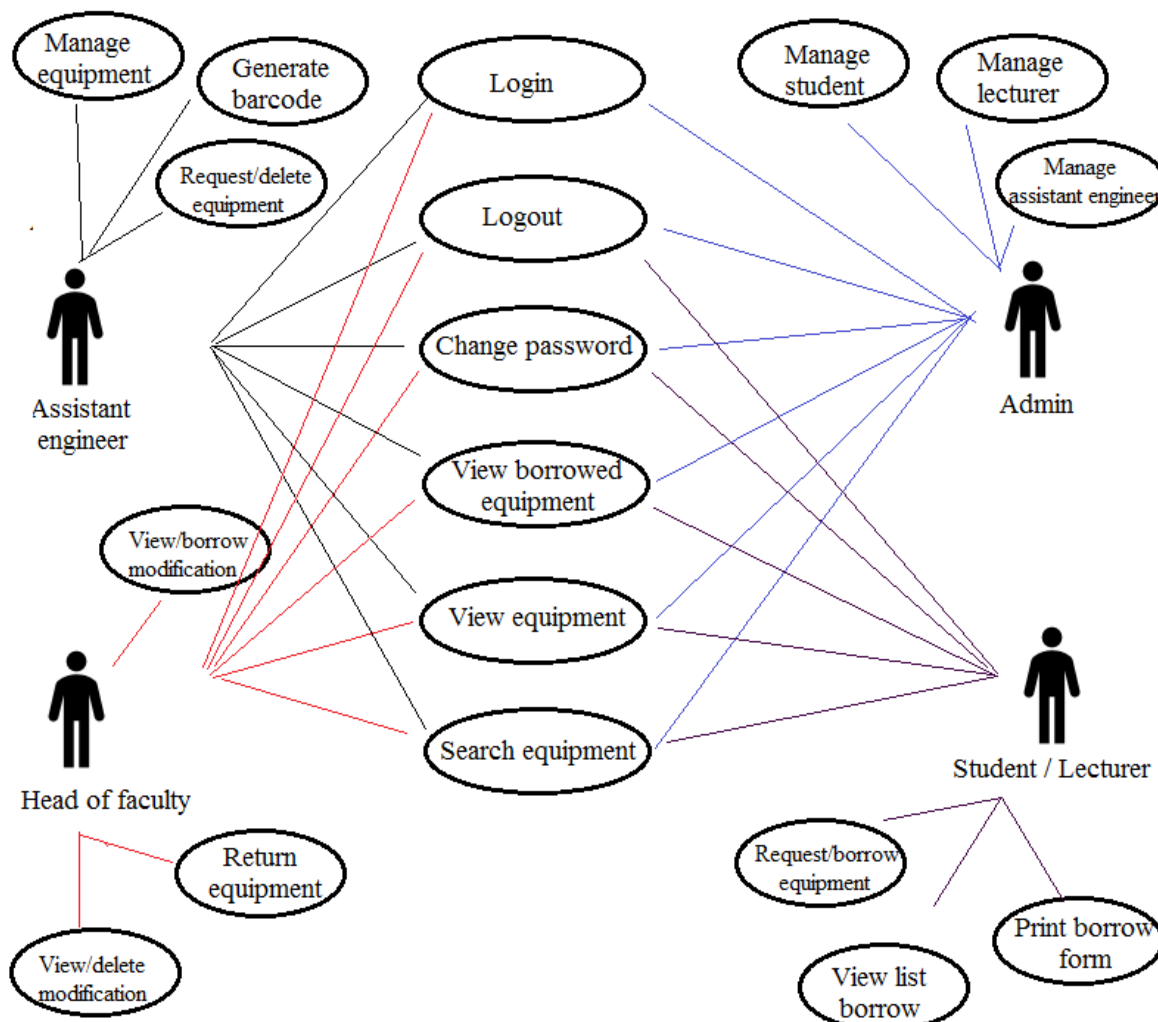
The main function of FKEPG-LIMS are as follows:

i.) Student or Lecturer can sent request to Head of Faculty or Assistant Engineer to borrow equipment.

ii.) Assistant Engineer can send request to delete equipment to Head of Faculty with reason.

iii) Head of Faculty or Assistant Engineer can view the notification sent by Student or Lecturer regarding the equipment issue.

iv) All user excluding Admin can search equipment by name, series number, level and lab.

Fig. 1: Use case diagram for FKEPG-LIMS.

3.1. User Characteristic

This section will briefly explain about the user characteristic and related functions that can be performed by each user in the system

3.1.1. Scope for Actor Admin

Use cases that can be perform by the actor admin are:
i. Login
ii. Manage Student
iii. Manage Assistant Engineer
iv. Manage Lecturer
v. Logout

3.1.2. Scope for Actor Student/Lecturer

Use cases that can be perform by the actor Student are:
i. Login
ii. View Equipment
iii. Search Equipment

iv. Request Borrow Equipment
v. View List Borrow
vi. Print Borrow Form
vii. Logout

3.1.3. Scope for Actor Assistant Engineer

Use cases that can be perform by the actor Assistant Engineer are:
i. Login
ii. Manage Equipment
iii. Generate Barcode
iv. Request Delete Equipment
v. View Borrowed Equipment
vi. View Equipment
vii. Search Equipment
viii. View Borrow Notification
ix. Return Equipment
x. Logout

3.1.4. Scope for Actor Head of Faculty

Use cases that can be perform by the actor Head of Faculty are:

i. Login
ii. View Borrow notification
iii. View Borrowed Equipment
iv. View Equipment
v. Search equipment
vi. Return Equipment
vii. View Delete Notification
viii. Logout

3.2. User Case Description

Each use case activity will contain a sequence diagram explain on the activities involve when the function being used. Table 1 shows the use case description that is used in the FKEPG-LIS

Table 1: FKEPG-LIMS case description

| No.	Use case	Description
1	Login	This use case provides the authorized access to the system specific functionality for registered user.
2	Logout	To end user session
3	Manage equipment	To add or edit equipment in the system
4	Generate Barcode	To generate barcode for the equipment
5	Request Delete Equipment	To notify Head of Faculty to delete equipment in the database
6	Manage Assistant Engineer	To add or delete Assistant Engineer in the system
7	Manage Lecturer	To add or delete Lecturer
8	Manage Student	To add or delete Student
9	Search Equipment	To search equipment by category such as search by series number, name, level and lab.
10	View Equipment	To view equipment details
11	Request Borrow Equipment	To allow Student or Lecturer to request borrow equipment to the specific Assistant Engineer or Head Of Faculty
12	View List Borrow	To allow Student or Lecturer to view list of equipment that has been borrow
13	Print Borrow Form	To allow Student or Lecturer to print the borrow form that has been approve by Assistant Engineer or Head Of Faculty
14	View Borrow Notification	To allow Assistant Engineer or Head Of Faculty to approve or not approve the request to borrow equipment by Student or Lecturer.
15	View Delete Notification	To allow Head Of Faculty to approve or not approve the request to delete equipment by Assistant Engineer
16	View Borrowed Equipment	To allow Assistant Engineer or Head Of Faculty to view list of the equipment that has been borrow by Student or Lecturer.
17	Return Equipment	To allow Assistant Engineer or Head Of Faculty to return the equipment that has been borrowed by Student or Lecturer.
18	Change Password	To allow actor to change their password

3.3. Case specification

Case specification outlines the actors, preconditions, flow of events and alternative flow of use case. Usually it will associate with activity diagram and sequence diagram to explains the state of every transaction and describe the flow of use case.

Use case Login is used as examples to explain the usage of case specification, activity diagram and sequence diagram used in the research. Table 2, Fig. 2 and Fig. 3 show the case specification, activity diagram and sequence diagram for Login respectively. It provides the security to the LIMS by requiring the users to key-in the username and password. Only authorized user can access to the server.

Table 2: Font Specifications for A4 Papers

| Item	Specification
Use Case ID	01
Use Case Name	Login
Brief Description	This use case provides the authorized access to the system specific functionality for registered user.
Actors	Admin, Head of Faculty, Assistant Engineer, Lecturer and Student
Pre-Condition	User must be authorized to use log in function
Basic Flow	1. User click on "LOGIN" 2. User key in Username and Password. 3. User click "Submit" button. 4. System verify Username and Password. 5. If Username and Password invalid,, go to A1 6. User home page will be display according to user type.
Alternate Flow	A1 – 1. Re-enter Username and Password 2. If valid, go to Basic Flow, Step 6
Post Condition	User successfully access to own account
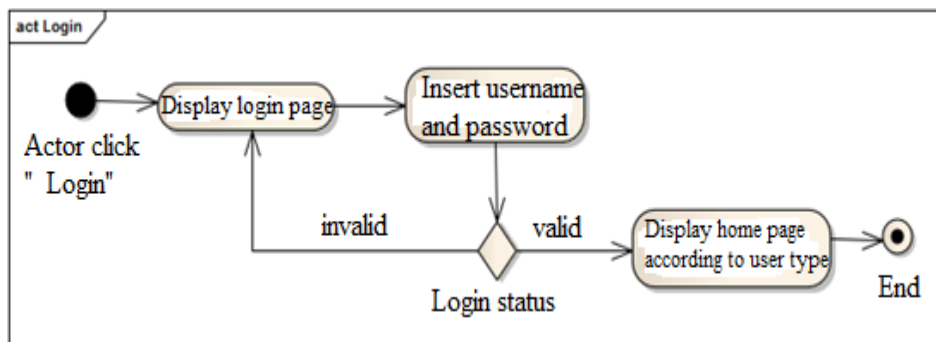
Fig. 2: Login activity diagram.
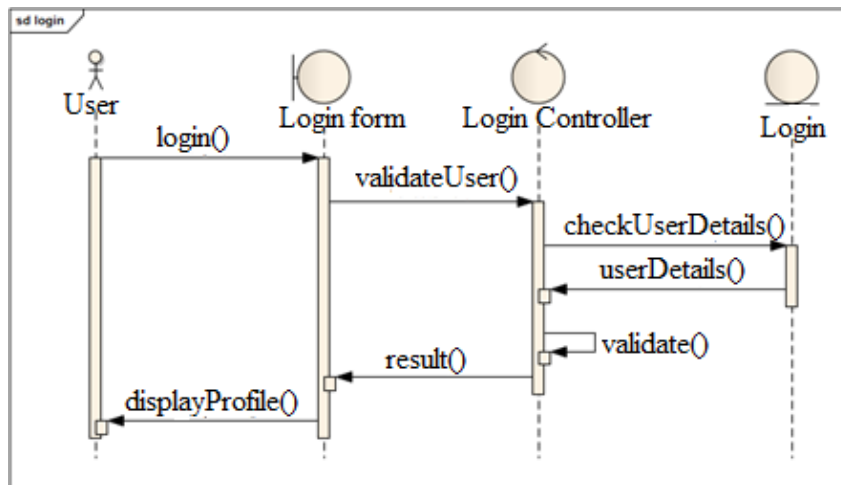
Fig. 3: Login sequence diagram.

3.4. Database Table

Table is a set of data elements using a model of rows and columns to describe the attribute and data type and create the database structure. Table 4 and Table 5 show the examples of database table used in FKEPG-LIMS for use case Equipment and Login respectively.

Table 4: Attribute and data type for use case Equipment

Attribute	Data Type	Length
Item_id	Int	11
Level	Int	11
Lab	Varchar	27
Item_name	Varchar	67
Series_no	Varchar	27
Model	Varchar	51
Quantity	Varchar	7
Date	Varchar	19
Status	Varchar	40
Person_ic	Varchar	26
Pj_id	Int	10
Image	Text	
Barcode	Text	
Availability	Varchar	50

Table 5: Attribute and data type for use case Login

Attribute	Data Type	Length
Id	Int	10
Login_id	Varchar	50
Password	Varchar	50
Access_level	Int	11
Name	Varchar	50

3.5. Development of FKEPG-LIMS database

Upon completion of planning, the next step is developing the web database. The process of developing the FKE PG Lab Equipment web database is divided into two main activities; which are:
  i) Installation of XAMPP to setup server environment in PC.
  ii) Development of database structure.

3.5.1. Installation of XAMPP

XAMPP is a free and open source cross-platform that is used to setup server environment in PC during system development. It is an application that prepacked with *Apache*, *PHP*, *MySQL* and other related tools. The application is designed to be run on *Linux*, *Mac* and *Windows* platform [9]. It can be downloaded at https://bitnami.com/stack/xampp
The installation process was easy and simple since XAMPP already provide an installation wizard for its users. Upon completion,

XAMPP Control Panel being opened and the interface is depicted in Fig. 4.
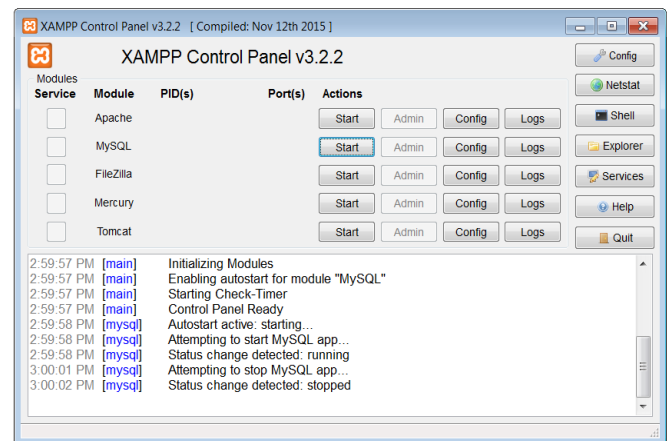

Fig.4: XAMPP Control Panel.

3.5.2. Development of Database Structure

The process began by starting the *Apache* and *MySQL* modules in *XAMPP* Control Panel. *phpMyAdmin* is used to setup the database structure. This is done by browsing at http://localhost/phpmyadmin/ Fig. 5 depicts the interface of phpMyAdmin on the localhost.
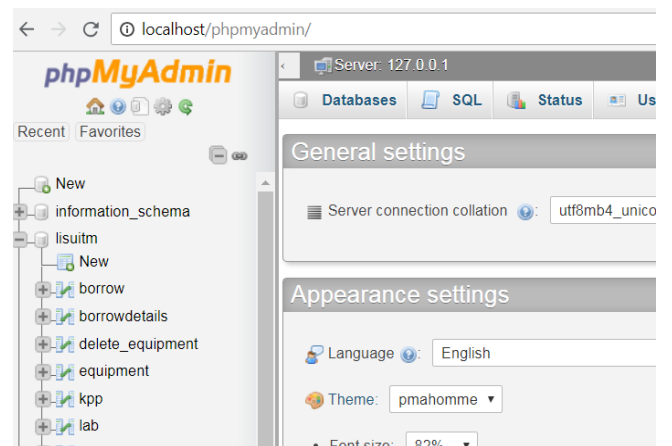

Fig.5: phpMyAdmin user interface on localhost.

After all tables being created, the next step is to develop the website. The website user interface is designed using *Adobe Dreamweaver* and *PHP* is the used to write the HTML Script to link the

web with the database so that it the users can access, retrieve and delete the information or data stored in the database.

4. Result and discussion

This section presents the results of the FKEPG-LIMS database. Fig. 6 depicts the table created in the database. It consists of 12 main tables namely New, Borrow, borowdetails, delete_equipment, equipment, kpp, lab, lecturer, login, pj, student and user.
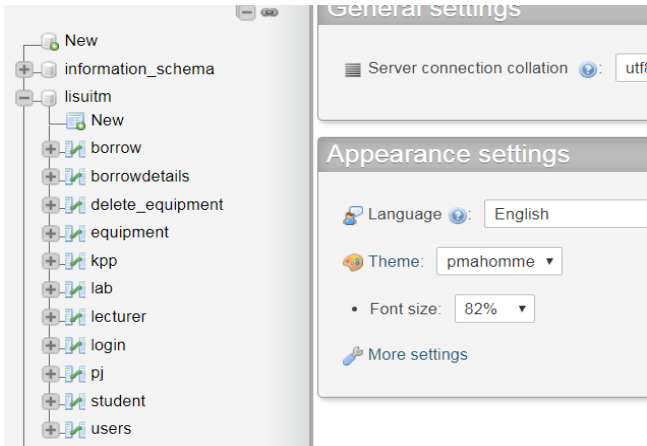

Fig.6: Main tables in FKEPG-LIMS database.

Next, Fig. 7 shows the list of lab equipment that is entered by the Assistant Engineer and being stored in the database.

n_id	level	lab	item_name	series_no	model	qu
1	1	PROCESS LAB	Digital Oscilloscope(2 channel, 100 MHz)	C010237	Tektronix/TBS1152B	1
2	1	PROCESS LAB	Digital Oscilloscope(2 channel, 100 MHz)	C010238	Tektronix/TBS1152B	1
3	1	PROCESS LAB	Digital Oscilloscope (2 channel, 100 MHz)	C010239	Tektronix/TBS1152B	1
4	1	PROCESS LAB	Digital Oscilloscope (2 channel, 100 MHz)	C010240	Tektronix/TBS1152B	1
5	1	PROCESS LAB	Digital Oscilloscope (2 channel, 100 MHz)	C010241	Tektronix/TBS1152B	1

Fig.7: List of lab equipment stored in the FKEPG-LIMS database.

Fig. 8, depicts the main webpage of FKEPG-LIMS. It starts with the Login page that requires the user to enter the username and password in order to access the database. After the user being authenticated, the user can start to view the database content based on the user's category.

Subsequently, Fig. 9 shows the web page that appears when students enter the FKEPG-LIMS. They are allowed to search, view and borrow the lab equipment. Students are also allowed to view the list of equipment they borrow as well as the availability of the equipment.
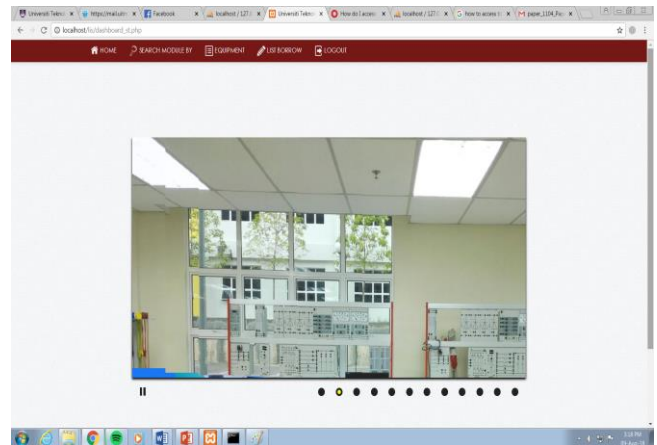

Fig.8: FKEPG-LIMS main web page.

Fig.9: Student Home web page.

Meanwhile, Figure 10, shows the webpage that shows the list of lab equipment available in FKEPG.
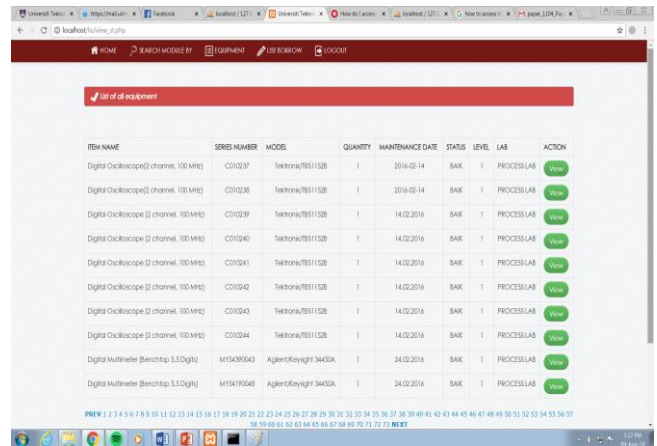

Fig.10: List of lab equipment in the web page.

Fig. 11 shows the page that displays list of equipment that being requested and borrowed by the student. This page is to assist the student about status on the requested equipment as well as to remind them to return the borrowed equipment.

Next, Fig. 12 depicts the page that only the Assistant Engineer can have accessed. On this page, the Assistant Engineer can update the equipment information and status, delete the equipment from the list and upload the equipment's barcode to the database.
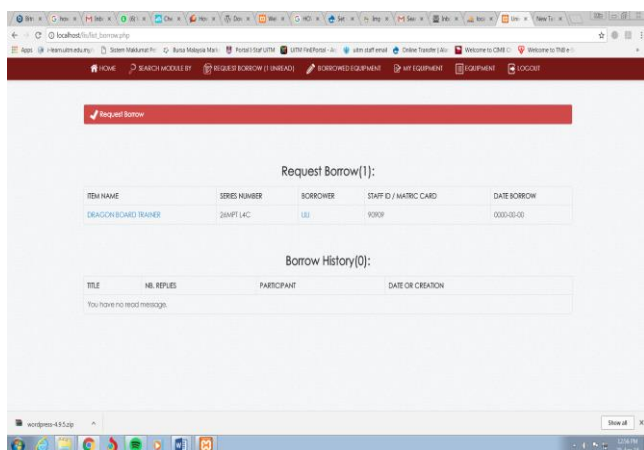
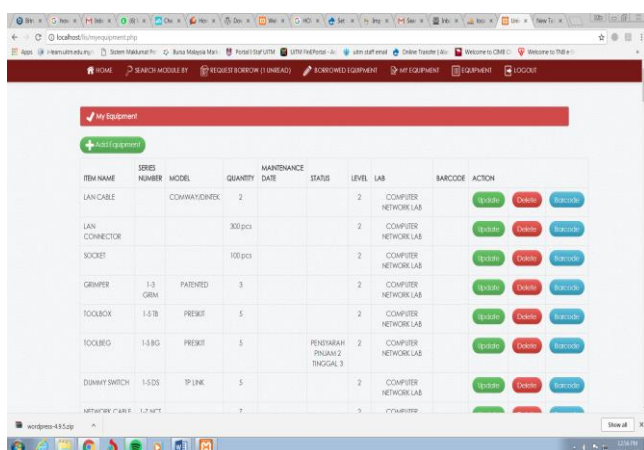**Fig.11:** Student request and borrow page.

Fig.12: Assistant Engineer equipment management page.

5. Conclusion

The FKEPG-LIMS is successfully being developed and designed using MySQL, PHP and Adobe Dreamweaver. The developed system is able to allow access to users based on their login category. The information of lab equipment and components are able to be entered, retrieve and deleted from the web server. This give benefits to all the faculty members. Future development will focus on the artificial intelligence-based data retrieval algorithm to increase the performance of the lab inventory management system.

Acknowledgement

References

[1] Krigel and Trukhnov, "SQL- Bible", Wiley Publishing Inc., 2nd edition, 2008.

[2] Pratt and Last, "Concept of Database Management", Cengeage Learning, 3rd edition, 2015.

[3] "What is a web server?", [online] https://developer.mozilla.org/en-US/docs/Learn/Common_questions/What_is_a_web_server, accessed: 04 July 2018.

[4] Hashim, N., M., Z., and Arifin, N., A., M., M., "Laboratory Inventory System", Interntional Journal of Science and Research (IJSR) India Online, vol. 2, issue 8, pp. 261-264, 2013.

[5] Hardono, Surjandari, I., Panjaitan, Y. A. B. and Rosyaidah, A., "Development of Theses Categorization System Search Engine using PHP and MySQL", International Conference on Information Technology and Innovation (ICITSI), 2017.

[6] Chandra, A., Jain, S., Qadeer and M. A., " Implementation of Location Awareness and Sharing System based on GPS and GPS using J2ME, PHP and MySQL", 3rd International on Computer Research and Development", pp. 216-220, 2011.

[7] Nielsen, K., Andersen, T., Jensen, R., Nielsen, J. H. and Chorkendorff, I., "An Open-souce Data Storage and Visualization back End for Experimental Data", Journal of Automationvol 19(2), pp. 183-190, 2013.

[8] "What are the benefits of using PHP MySQL Development Services?" [online] https://www.brainvire.com/blog/benefits-of-php-mysql-development-services/, accessed 04 July 2018.

[9] "XAMPP Apache + MariaDB + PHP + Perl", [online] https://www.apachefriends.org/index.html , accessed: 30 October 2017.

[10] "MySQL", [online] https://www.mysql.com/, accessed: 30 October 2017.