Shifting The Information Organization Module Implementation of Library Management System from Client-Server Architecture to Web-Based Application

Wan Ainol Mursyida binti Ahmad Tarmizi[1], Saidatul Akmar Ismail[2] and Ahmad Zam Hariro bin Samsudin[2]

[1]Knowledge Link Sdn Bhd, Petaling Jaya, Selangor, Malaysia
[2]Faculty of Information Management, Universiti Teknologi MARA Selangor, Puncak Perdana Campus, Shah Alam, Selangor, Malaysia

Email: saidatulakmar@uitm.edu.my

Abstract. This paper is about the development of Web based Cataloging System as a solution to replace the client-based cataloging system. The sole prerequisite for using this cataloguing system is internet connectivity. In comparison to client-based cataloguing systems, web-based cataloguing systems offer shorter and more convenient installation times. In order to address issues users of client-based cataloguing systems have, the main goal of this project is to investigate web-based cataloguing systems. Creating a web-based cataloguing system will help users with issues they have with client-based cataloguing systems. to assess the system for online cataloguing. The library system and its corresponding web-based user interface are the main subjects of the study. The library system, which is a comprehensive system in the education sector, comprises of more than 20 modules. One of the major modules, the cataloguing module, will be the main topic of development and research for this project. In order to catalogue library materials, a librarian must complete a number of tasks in this module. These functions—save, save and index, index, unindexed, duplicate record, delete record, search from index and buffer, add tag, term search, add subfield, non-filling indicator, and authority link—will be built for this cataloguing module. With the help of the function save, librarians can catalogue library resources and temporarily save them in a table.

Keywords: Classification, cataloging, library management system, cataloguer, information management.

1   Introduction

As a replacement for client-based cataloguing systems, the development of web-based cataloguing systems is currently widely recognised. The ability for the librarian to access the module from any location at any time makes this system convenient to utilise. Thanks to technology, consumers can now submit their library requests at any time, from anywhere in the globe. Libraries, their resources, and their services have easily transitioned to the digital and virtual world of the Internet in this post-pandemic context. As of now, libraries' information management systems have turned their focus to important components including "reliability and security, user friendly interface, advance searching options, use of library standards, online upgradation" and other options (Khan and Ayesha, 2021) as the library needs increase. A software programme called a Library Management System (LMS) is designed to manage a library's basic administrative tasks. LMS is used by libraries to manage both their member relations and asset collections. LMS assist libraries in keeping track of the books, their checkouts, and the subscriptions and profiles of members.

Web-based library systems are now proliferating everywhere. The business strategy is aggressive. By offering clients a more effective, user-friendly, and proven library system, LMS researchers have started to establish their niche and brand. The client-based architecture library system had transformed themselves into web-based architecture library system using the current technologies. Those days most digital library preferred using client server archi-tecture which had the drawbacks such as the system scalability. The essential idea driving a client server-based architecture was to disperse tasks between the providers of an asset (which are the servers), and the ones who ask for that asset (the clients) responses (Vlad Mihai Alecu, 2012). Due to the fact that they were the ones that communicated requests to the servers, the clients had the power to determine when a session started and ended. The client re-ceived the computation's result, and the user saw the results on the client (Farhan Bukhari, 2012). The client-based architecture of library systems has been extensively utilised by librarians in Malaysia. Users or librarians had to install the systems on their own computers or gaming consoles in order to use the client-based application.

The library automation systems have applications similar to any other automation system such as the follow-ings:

i. Cataloguing
ii. Acquisition
iii. Foundation
iv. Serials Management
v. Circulation
vi. Stocktake

Each module has a distinct process flow that helps users—like librarians—complete daily tasks. The cata-loguing module, which serves as the brains of library systems, is the subject of this study. Information organisations play a crucial role in helping librarians manage library collections and provide end users with the information they need. The application must connect to a server for the library system to function effectively. The clients are not represented only by applications that the users explicitly install on

their machines. Once the users interact with the library system page, the client side of the system starts sending requests to the library system server, which then send feedback to the client application.

To implement an efficient and convenient architecture, the client-based library systems move forward toward web-based architecture library system. The fast development of web, intranets, extranets and other interconnected worldwide systems in the 1990's drastically changed the capacities of data frameworks in associations. Industries' project management are migrating their operations from an existing computer-based application, to a web-based application. The aspects of "application development, platform development, software utilization, and efficient display interface" based on the industries' are vital process elements (Yousif, & Zakaria, 2022). Modern systems deliver innovative solutions and Applications that users voluntarily install on their computers do not entirely represent the clients. The client side of the system begins sending queries to the library system server once users begin interacting with the page, and the server subsequently sends feedback to the client application.

The client-based library systems progress toward the web-based architectural library system in order to cre-ate an effective and practical architecture. The capabilities of data frameworks in organisations underwent a significant change in the 1990s with the rapid development of the internet, intranets, extranets, and other globally connected systems. The management process uses the most recent systems, tools, and approaches (Adamson, 2010). These systems function in the same way as those that were established fifty years ago. What has changed is that we now value considerably more substantial network cross-sections across both comparable and unique framework parts, as well as significantly higher amounts of system capacity reconciliation across applications.

The following subsection includes the issues related the current use of client-based architecture cat-aloguing systems.

1.1 Research Problem

Due to the excessive number of problems with client-based architecture cataloguing sys-tems, including scalability, most libraries are transitioning to web-based architecture. The cost of maintaining the system's scalability was also rather significant, and the client-based system architec-ture's servers needed regular maintenance. The client-based server's failure tolerance and downtime are additional problems. There is only one server unit in a client-based cataloguing system architecture, and if there are heavier loads or bandwidth spikes, there is a strong likelihood that it may fail.

One of the situations is shown here. For instance, one of the manufacturers of the library system in Malaysia is Company XYZ. For more than 20 years, XYZ has sold library systems to public universities and other organisations. In addition to creating library systems, company XYZ also offers maintenance for existing libraries that have already subscribed to the system. Maintenance signifies that customers can contact Company XYZ if they experience any issues with this library system. The issue was quickly resolved by Company XYZ. In Malaysia, this company has already formed

more than 100 library groups and has consulted with them. With this client-based cataloguing system, they have managed to survive for a very long period. Numerous modules in client-based library systems help librarians complete their daily process flow. They are now having trouble with it because there are more rivals with web-based cataloguing systems available, which are easier for customers to use.

This situation prompts the researcher to start this project's early research. This study's goal is to pinpoint the problems with client-based cataloguing systems that make them difficult to use. There are eight respondents in all during the interview sessions. They are the trainers, programmers, clients, and software engineers. The investigation continues to address the following inquiries. The following are the study's research questions:

i. What should I research in web-based cataloguing systems to address issues users have with client-based cataloguing systems?
ii. How can a web-based cataloguing system be created for users to lessen the issues they have with client-based cataloguing systems?
iii. How should the online cataloguing system be evaluated?

1.2 Objectives

The following goals need to be emphasised:
i. To research web-based cataloguing systems in order to address issues that users of client-based cataloguing systems are having.
ii. To create a web-based cataloguing system will help users with issues they have with client-based cataloguing systems.
iii. To assess the system for online cataloguing.

1.3 Scope

The library system and its corresponding web-based user interface are the main subjects of the study. The library system, which is a comprehensive system in the education sector, comprises of more than 20 modules. This project's development and research are centred on the cataloguing module, one of its main modules. In order to cata-logue library materials, a librarian must complete a number of tasks in this module. The features that this cataloguing module has created include save, save and index, index, unindex, duplicate record, delete record, search from index and buffer, add tag, term search, add subfield, non-filling indicator, and authority link.

1.4 Significance

In order to organize library items, the project intends to give librarians or users with an accessible web-based cataloguing system with key features, validated, and a user-friendly system. Librarians may effectively store, index, unindex, delete, and duplicate library material records with the use of an integrated web-based cataloguing system. The advantages include less problems and difficulties with the client-based cataloguing system; assistance for librarians to quickly and simply categorise library materials; and,

finally, the technique for creating querying and an-alytical tools offers insights in the web-based cataloging system development.

2   Literature Review

2.1 Library Management System (LMS) in relation to Cataloging Module

Most users feel more at ease using a system that has been around for a while and has a solid reputation. LMS is a tool to assist any libraries that are still managing their library using the outdated method. A central database cannot be built since the information is not available in a database, the traditional method of looking for a book using manual labour is inconvenient, it is impossible to generate reports quickly, and information regarding the issuance and return of the books is not adequately kept (UKessays, 2015). However, by applying the LMS, the problems mentioned earlier can be overcome.

A relational database, software that interacts with the database, and two graphical user interfaces make up a learning management system (LMS) (one for users, one for staff). The majority of integrated library systems combine distinct programmes' individual software functionality into a single interface (Adebesin, 2015). The LMS modules that are most frequently used are acquisition, cataloguing, circulation, and serials. Additionally, library management systems maintain the database for adding new books and tracking borrowed books with their due dates.

2.2 Client-Server Architecture in Comparison with Web-based Application: An Overview

The term "client server architecture" refers to a system that consists of two parts: a server that provides administration and a client or customer that requests administration from the server. These two parts together create an architecture with proper responsibilities that resembles a buyer-maker relationship. Therefore, both elements work together to create a distributed architecture that resembles a consumer-producer relationship. Workstations serve as clients' primary locations, whereas network nodes house servers.   This computing model works best when both the client and the server have certain activities that they undertake on a regular basis (Encyclopaedia Britannica, 2017). Figure 2.2 is an example of client-server architecture.
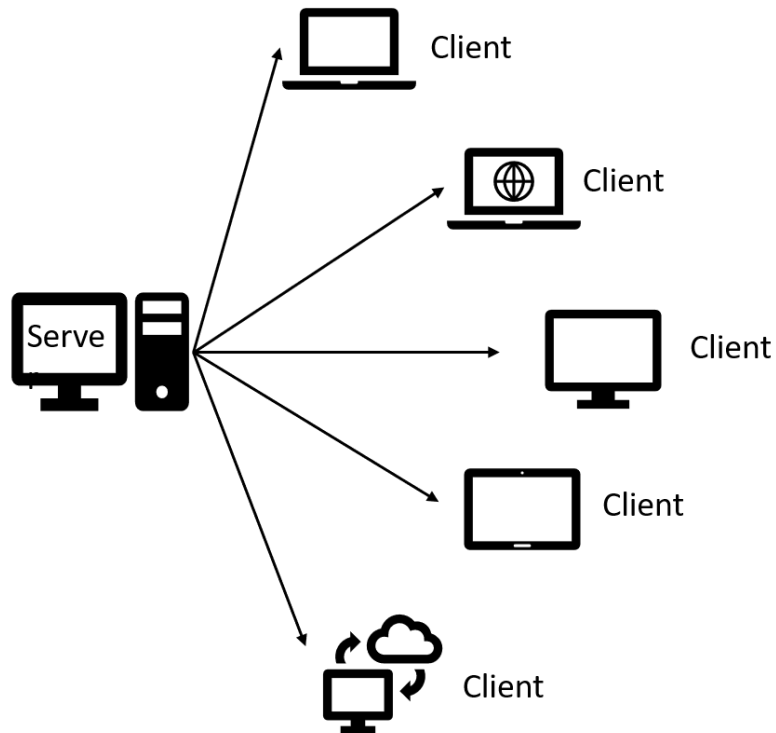
Figure 2.2: Client Server Architecture (adapted from Navaneeth Krishnan, 2001)

Lewandowski (1998) discusses issues of alternative designs of client server architectures; fat servers vs. fat clients. The client server engineering with fat servers expect that customers have restricted assets. In this sort of engineering, clients send benefit solicitations to the server and the server gives the administrations. To reaction the client demands, the server may get to objects and do some calculations as per a certain intelligent business executed at the server. The consequence of the calculation is sent to the client, and the customer displays the outcomes to the client.

On the other hand, the Web-based application of library management system does not require any server. The application only requires workstations that users can use to browse web, and able to use the latest features, total redundancy of data for backup and recovery, and can run all connections from a single location. In addition, the application does not require any data lines and communication and downloaded software to run the system.

Table 2.2: Client Server Based System versus Web-based System
Source: Web-Based Vs Client/Server Comparison Patient Account Services (2017)

Feature	Client/Server	Web-Based
Computer Servers (Multiple)	Requires 3 or 4 servers	Does not require servers
Workstation Equipment	All the workstations need to have the same version of the application installed in order to meet certain specifications and to work reliably	Requires workstations of the user for standard web browser
Using the Latest Features	Yes, yet just if the client keeps the servers stacked with the most current discharge and perform the scheduled server upgrades	Yes
Data Backup/Recovery	Yes, data backup is generally performed toward the day's end. Many practices use remote backups notwithstanding to tap backup, so information is effectively recoverable. Recuperation is conceivable if the backup source is solid from the earlier day, month or year	Total redundancy of data
Data Lines and Communications	Requires Virtual private network (VPN) as the data lines and communications. The purpose of it is to communicate with remote offices	Does not require any data lines and communication
Operational Simplification	It requires application software that has to be loaded on every workstation. There is a possibility for the application to conflict with programs that have been installed previously	Does not require any software to be downloaded
Resource Consolidation	Each system requires all interfaces and information links implemented to their servers	All connections run to single location
Implementation Costs	Typically, $20,000–$60,000 based upon practice size.	Usually less than $10,000
Value	Huge venture and execution costs	Great esteem for speculation

Table 2.2 displays the dichotomy of client server-based system and web-based system. Nine features of both systems are compared as written in Patient Account Services (no date). The first feature is the multiple computer servers which are required for client-based system compared to no server is needed for web-based system. The second feature is the workstation equipment. In contrast to a web-based system, which only requires user workstations for ordinary online browsing, all workstations must have the same version of the application installed in order to function properly and meet certain requirements. Utilizing the most recent features or components is the third feature. The current features appear to be present in both systems. However, the client-server architecture is burdened with performing the scheduled server updates and keeping the servers stocked with the most recent update. The fourth feature is the data backup/recovery. The client-server system often performs data recovery or backup around the end of the day. Although many procedures use distant backups to tap backup, information is still efficiently recoverable. If the backup source is reliable from the previous day, month, or year, recovery is possible. In contrast, the web-based solution has completed data redundancy.

Next and the fifth feature is the data lines and communications, as also discussed in Patient Account Services (no date). The client-server system requires virtual private network (VPN) as the data lines and communications. VPN is used to communicate with distant offices. The web-based system, on the other hand, does not need any communi-cation or data lines. The operational simplification is the sixth characteristic. Every workstation must have application software loaded in the client-server system. The application can interfere with other apps that have already been installed. On the other hand, no software must be downloaded in order to use the web-based system. The sev-enth feature is the resource consolidation. Each client-server system requires all interfaces and information links implemented to their servers. On the other hand, all web-based connections run to single location. The eighth feature is the most important aspect of management budget consideration, that is the implementation costs. The cost of client-server system amounts typically around $20,000–$60,000 based upon practice

size. On the other hand, the web-based system spends less than $10,000. Finally, is the ninth feature, that is value. The client-server system involves a huge venture and execution costs. In contrast, the web-based system is still ongoing and in great esteem for speculation.

Next section is the discussion on the research approach and methodology that was adopted throughout the study.

3 Methods

In order to describe the aims and goals of the system being developed, the scope and significance of the project, as well as to identify the issues with existing systems and advocate the use of a new system or modification of an existing system, preliminary research has been undertaken. Before putting the system development into action, the primary goal of this phase is to have a deeper understanding of the system that has to be constructed. The outcomes of this phase have an impact on the project's goals, objectives, and overall system to be constructed. In this project, the qualitative research included the design and execution of structured interviews. Interviews with software engineers, trainers, clients, and researcher/business analysts were done. At this stage, the structured interview had yielded all the requirements.

The need of creating a web-based cataloguing system has been highlighted by the researcher after studying the issues that clients, software engineers, trainers, and researchers confront. The purpose of the interviews with software engineers and researchers was to learn about any installation issues with client-based cataloguing systems. Through these interview sessions with trainers and clients, the researcher gathered concerns about the client-based cataloguing system's procedures and design. In addition to that, the researcher has also gathered requirements of web-based cataloguing system by conducting interviews with them.

In the next section, the interview's findings are presented and discussed. The scope of creating the system was constrained during the requirement phase. To ensure a smooth development process, the requirements were developed. At this point, the test strategy was also planned.

4 Findings

The preliminary findings from the conducted interviews are reported in this section. The primary users of this system, which was created for libraries, were catalogers. Trainers, software engineers, and programmers were also regarded as users of this system in addition to library patrons. Thus, having an interview was the best method for gathering data. Users of client-based cataloguing systems were more aware of the system's shortcomings and of the key features included in web-based cataloguing systems.

The following sub-sections report the findings of first and second interview sessions. The first interview session was conducted with software engineers and programmers and second interview session was conducted with trainers and a client. The result of the interviews with the software engineers, programmers, trainers and clients were also important to assist in developing this system.

4.2 First Interview

The initial interview took place at XYZ Company. Three software engineers and two programmers participated in the initial interview. The major goal of conducting this interview was to gain a general understanding of the client-based system's disadvantages in terms of installation and system development. Additionally, this interview was conducted to learn more about what a web-based cataloguing system would need.

Icebreaker questions were asked at the beginning of the interview. The interview began with questions about the installation and development of a client-based cataloguing system after the interviewer and interviewee introduced themselves. In order to comprehend the disadvantages of the client-based cataloguing system, concerns pertaining to its creation and installation were first raised. According to the interviewer's understanding, 90% of interviewees, or four out of five, are dissatisfied with the client-based cataloguing system.

When asked the interview participants about the the installation and development of client based cataloging system, 90% of interviewees, or four out of five, are dissatisfied with the client-based cataloguing system. The interviewee responded that they would prefer a web-based cataloguing system with simple navigation between functions. Additionally, the web-based cataloguing system ought to offer all the features that the client-based cataloguing system now has.

The initial interview revealed that software developers, researchers, and business analysts had a difficult time installing client-based cataloguing systems. A web-based cataloguing system would alleviate this difficulty.

4.3 Second Interview

The purpose of the second interview was to collect information on the shortcomings of client-based cataloguing system designs and functionality. Two trainers and one client participated in this interview session. The company did not permit the researcher to see the clients in person because it was private and secret, which is why there was only one (1) client interviewed.

When asked the interview participants on their opinions of what were the important functions in cataloging system, the participants shared their thoughts on the critical roles played by the cataloguing system. The participants highlighted their biggest worry that the cataloguing library system had to adhere to all of the predetermined processes. The client system did not permit customers to skip any crucial ones. It appears from the second interview that 99.9% of respondents were dissatisfied with the client-based cataloguing system's design and functions. The interviewees stated that although client-based cataloguing systems had several benefits, consumers found the systems to be more cumbersome. They also offered ideas for the layout and features of a web-based cataloguing system. This could serve as a way to gather requirements for a web-based cataloguing system.

The web-based cataloguing system has undergone unit testing by the researcher. Each component or feature is tested separately. This aids the researcher or business

analyst in locating the problematic functions. There are 11 units in the web-based cataloguing system, and all of them were tested. The results of the testing are shown in Tables 4.1 through Table 4.11.

The results of testing are presented in the form of table below. Every component of the system that accepts inputs has undergone testing to determine whether there is a chance that the system would malfunction. Based on the accepted outcomes for each control in each function, each function is put to the test. The units that have undergone testing include the duplicate record, login screen, add new cataloguing record, search for existing cataloguing record, view, edit, and delete cataloguing record, control Tag Modal, and edit terms modal. The functions involved in module testing are listed below.

Table 4.1: Actions involved in testing

Criteria	Expected Results	Obtained Results	Pass/ Fail
Template Selection	Loads pre default template and loads available tags, indicators and subfields for the particular template	The list of templates loaded and once the template is selected, tags, indicators and subfields are loaded	Pass
Tag Help Button	Able to redirect page to Library of Congress (LOC) website link	Page is redirected to LOC website	Pass
Add Tag	Able to load add new tag form	Loaded the add new tag form	Pass
Add Control Tags	Able to load control tag form	The form is loaded successfully	Pass
View Subfields	Able to load new 'view subfields' form	The new 'view subfields' form is loaded	Pass
Duplicate Record	Able to duplicate the record displayed	The record is duplicated successfully	Pass
Save Record	Able to save record and generate buffer number for the particular record	The record is saved into database and the buffer number is generated	Pass
Index Record	Able to index record and generate control number	The record is saved into database and control number is generated	Pass
Save and Index Record	Able to save and index record at one click and generate control number	The record is saved and indexed successfully and control number is generated	Pass

Table 4.1 displays a list of criteria involved in the testing including Template Selection, Tag Help Button, Add Tag, Add Control Tags, View Subfields, Duplicate Record, Save Record, Index Record, Save and Index Record. The test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement.

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Table 4.2: Search for Existing Cataloguing Record

Criteria	Expected Results	Obtained Results	Pass/ Fail
Search Button	Able to load search modal in order to retrieve existing cataloguing record	The search modal is loaded and the record retrieved successfully	Pass
Search Record Button	Able to display results of searched record	The record was retrieved successfully	Pass
Click on Record	Able to display cataloguing record for that particular selection	The cataloguing record was displayed successfully according to selected record	Pass
Add Tag	Able to load add new tag form	Loaded the add new tag form	Pass
Add Control Tags	Able to load control tag form	The form is loaded successfully	Pass
View Subfields	Able to load new 'view subfields' form	The new 'view subfields' form is loaded	Pass
Duplicate Record	Able to duplicate the record displayed	The record is duplicated successfully	Pass
Save Record	Able to save record and generate buffer number for the particular record	The record is saved into database and the buffer number is generated	Pass
Index Record	Able to index record and generate control number	The record is saved into database and control number is generated	Pass
Save and Index Record	Able to save and index record at one click and generate control number	The record is saved and indexed successfully and control number is generated	Pass

Table 4.2 displays a list of criteria involved in the testing of search for existing cataloguing record including Search Button, Search Record Button, Click on Record, Add Tag, View Subfields, Duplicate Record, Save Record, Index Record, Save and Index Record. The search test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement.

Table 4.3. Edit Cataloguing Record

Criteria	Expected Results	Obtained Results	Pass/ Fail
Unindexed/Modify	Enable form to edit mode and if the record is an index record, it should generate buffer no.	The action enabled user to edit the record and buffer number is generated for the record	Pass
Add Control Tags	Able to load control tag form	The form is loaded successfully	Pass
View Subfields	Able to load new 'view subfields' form	The new 'view subfields' form is loaded	Pass
Duplicate Record	Able to duplicate the record displayed	The record is duplicated successfully	Pass
Save Record	Able to save record and generate buffer number for the particular record	The record is saved into database and the buffer number is generated	Pass
Index Record	Able to index record and generate control number	The record is saved into database and control number is generated	Pass
Save and Index Record	Able to save and index record at one click and generate control number	The record is saved and indexed successfully and control number is generated	Pass

Table 4.3 displays a list of criteria involved in the testing of edit cataloguing record including Unindexed/ Modify, Add Control Tags, View Subfields, Duplicate Record, Save Record, Index Record, Save and Index Record. The edit record test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement.

Table 4.4. Duplicate Record

Criteria	Expected Results	Obtained Results	Pass/ Fail
Duplicate Record	Able to copy the same record with blank buffer no.	Record is copied and blank buffer no is generated	Pass
Save Record	Able to save record and generate buffer number for the particular record	The record is saved into database and the buffer number is generated	Pass
Index Record	Able to index record and generate control number	The record is saved into database and control number is generated	Pass
Save and Index Record	Able to save and index record at one click and generate control number	The record is saved and indexed successfully and control number is generated	Pass

Table 4.4 displays a list of criteria involved in the testing of duplicate record including Duplicate Record, Save Record, Index Record, Save and Index Record. The duplicate record test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement.

Table 4.5. View Cataloguing Record

Criteria	Expected Results	Obtained Results	Pass/ Fail
Display record	Able to load and view tags, indicators, and subfields	The list of tags, indicators, and subfields are loaded and able to view	Pass

The next unit that was tested is View Cataloging Record. The result of this unit testing is displayed in Table 4.5. This screen is where users view all the retrieved record or edited record. The view record test involves the comparison of the expected results and the obtained results. The display record criterion passes the test requirement.

On the other side, clients can also get rid of existing cataloguing. Before deleting a cataloguing record, users must unindex the record. The confirmation screen before removing the record is depicted in Table 4.5. The results of the remove cataloguing unit testing are shown in Table 4.6.

Table 4.6: Outcome of delete cataloguing

Criteria	Expected Results	Obtained Results	Pass/ Fail
Unindexed/Modify	Enable form to edit mode and if the record is an index record, it should generate buffer no.	The action enabled user to edit the record and buffer number is generated for the record.	Pass
Confirmation modal	Able to confirm with users if they want to delete the record	Confirmation is asked from users before deleting the record. It successfully deleted the record, if users want to delete the record.	Pass

Table 4.6 displays a list of criteria involved in the testing for outcome of delete cataloguing including Unindexed/ Modify and Confirmation Modal. The outcome of delete test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement.

Another item evaluated in this project is the modal for control fields. Only some tags, such tags 000 to 008, have control fields. These tags' fields must have pre-default values and adhere to Machine-Readable Catalog (MARC) requirements. Users are unable to input the values for these tags. The control field modal screen is shown in Table 4.7 and displays the test results.

Table 4.7: Control Fields Modal

Criteria	Expected Results	Obtained Results	Pass/ Fail
Select control fields attributes	Able to select all the available control fields attributes	The list of control fields attributes in the modal is successfully selected	Pass
Add button	Able to add the selected attributes and it appends to the cataloguing list in the main page	The selected attributes are added and the attributes are appended in cataloguing list in main page	Pass

Table 4.7 displays a list of criteria involved in the testing of control fields modal including Select Control Fields Attributes, and Add Button. The control fields test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement. Users can add new tags in addition to those that are already visible in the record using the Add Tag Modal feature of the cataloguing organization. The outcome of this unit testing is displayed in Table 4.8.

Table 4.8: Add Tag Modal

Criteria	Expected Results	Obtained Results	Pass/ Fail
Tag, indicators and subfields selection	Able to load and select tags, indicators and subfields list	Selection list for tags, indicators and subfields are loaded	Pass
Add button	Able to add new tag, indicator and subfields in main screen	New tag, indicator and subfields added to the main screen	Pass

Table 4.8 displays a list of criteria involved in the testing of add tag modal including Tag, Indicators and Subfields, and Add Button. The add tag test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement. View subfields modal, which allows users to add or update terms for cataloguing records, is a critical component of unit testing. Users have access to indication help, subfield sorting, subfield addition, word search, subfield deletion, and subfield duplication. Table 4.9 displays the result for this unit testing.

Table 4.9 displays a list of criteria involved in the testing of edit subfields modal including Edit Terms, Add Subfield, Term Search, Sort Subfields, Indicator Help, Duplicate Subfields, Delete Button, and Add Button. The edit subfields test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement.

Table 4.9: Edit Subfields Modal

Criteria	Expected Results	Obtained Results	Pass/ Fail
Edit terms	Able to edit terms for each recorded subfield	The terms are edited	Pass
Add subfield	Able to load add new subfield modal	Add new subfield modal is loaded	Pass
Term search	Able to load term search modal and perform search	The term search modal is loaded	Pass
Sort subfields	Able to sort subfields	The subfields can be sorted	Pass
Indicator help	Able to load pre default indicators to change the existing indicators	Pre default indicator list is loaded and the existing indicator can be changed	Pass
Duplicate subfields	Able to duplicate subfields that is displayed in the screen	The subfields are duplicated successfully	Pass
Delete button	Able to delete the existing subfields	The subfields are deleted successfully	Pass
Add button	Able to add subfields and terms. Appends to the main list	The subfields and terms added and appended to the main list	Pass

Table 4.10: Login Modal

Criteria	Expected Results	Obtained Results	Pass/ Fail
Input username and password	Able to key in username and pass word in the login screen.	Username and password keyed in successfully	Pass
Show password	Able to show password if user selects this function.	It shows the actual password, if this function is selected	Pass
Login button	If username and password correct, user able to login successfully. If username or password is invalid, it prompts a message.	User able to login with right username and password but if the username or password is wrong, message is prompted	Pass

Table 4.10 displays a list of criteria involved in the testing of login modal including Input Username and Password, Show Password, and Login Button. The login test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement.

Table 4.11: Indicator Help

Control	Expected Results	Obtained Results	Pass/ Fail
Indicator Help Button	Able to show modal with list of indicators.	Modal with list of indicators is loaded	Pass
Update Button	Able to change existing indicators with new indicator values.	Existing indicators are changed with new selected indicator values	Pass

Table 4.11 displays a list of criteria involved in the testing of indicator help including Indicator Help Button, and Update Button. The test involves the comparison of the expected results and the obtained results. All criteria pass the test requirement. According to the results of the unit testing, the system was successful because all the units created by the researcher and business analyst passed the testing requirements. Among the eleventh testing made, the first four units tested the most important features. They were Add New Cataloging Record, Search Existing Cataloging Record, Edit Cataloging Record and Duplicate Record. The following section is the discussion about the

results of the interviews and the testing made by the researcher on the design of web-based cataloguing system

5 Discussions

The researcher developed the system while also conducting study in important areas and features of the project. The accomplishment of the goals made the project a success. The user's acceptance of the system was another factor in the system's success. Interview sessions were used as part of the data gathering process to learn more about the current system in use in libraries and its shortcomings. The interview allowed for the conclusion of user requirements. The adopted technique played a role in the project's success as well. This project was carried out in an orderly manner thanks to the adoption of a hybrid methodology that combined Waterfall and Agile methods. All functions in the web-based cataloguing system were successfully accomplished with the aid of extensive study, including the installation of system features and functions. The issues that several software engineers, programmers, clients, and trainers encountered can be resolved with the help of this system. The web-based system does have significant limitations, despite the success rate of the system's creation and deployment.

Every system has limitations, and every event has limitations. There are various areas where the system's capabilities have been restricted as a result of the time limit and the scarce resources. As a researcher and system developer, the researcher suggests that the system's user interface and functionalities be improved. In order to improve the system to its potential perfection, the limitations will be the source of future modifications.

The following modifications will be among those suggested:

i. Indexing and batch indexing should be included. The development of the existing system only supports the indexing and indexing of a single content. Because there are multiple materials for the librarians to catalogue in a single day, this can take a lot of time. They could become frustrated if they have to catalogue the materials one by one. They are able to categorise multiple materials at once because to batch indexing and indexing.

ii. Z39.50 protocol should be included to web-based cataloguing systems. With the existing technology, users can search their local database for bibliography records and get them. Data searching and retrieval from online databases are made possible by this protocol. Z39.50 is used to search the Online Public Access Catalogues, or OPAC, of library holdings over the Internet (TechTarget, 2017). Because the bibliography information in the online database is collected directly from the publisher, ensuring the records are accurate, this enables librarians to catalogue works without making any human errors.

iii. to enable the librarians to catalogue the library's materials by scanning them. The time spent cataloguing library materials could be cut down, as could their workload. This makes it possible for librarians to precisely and automatically catalogue their collections. They do not have to spend time

> manually classifying things or looking for existing bibliography information in databases.

6   Conclusions

In summary, project management and action research rank among the researcher/most developer's significant learning experiences. The researcher/developer has discovered that when a project is managed effectively, the likelihood that it will be successful is high. The researcher and developer succeeded in finishing the job in the allotted time. Time management is a useful skill to learn. The future and the working environment may benefit from this experience. In terms of action research, the researcher/system developer was able to create a strong system by first doing methodical study. The researcher or developer also learns how to approach businesses to conduct informational interviews. The researcher/developer also picked up new Java and JSP programming techniques. The researcher or developer has to learn how to translate the algorithms into programming codes in great detail in order to construct the algorithms. As a result, the learning experience gained from working on this project will be highly helpful for the researcher and developer's future endeavours.

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