

Library Management System

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Abstract: The Library Management System is made to handle and preserve the library's records. Some libraries still use manual forms to manage data instead of computerized library management systems. The system's primary goal will be to introduce a better approach for the library to efficiently address difficulties, which will help to overcome the issue at hand. The library management system is being developed using a waterfall development approach in order to ensure that the system is thoroughly analyzed before development begins. Both the administration and the patrons of the library would benefit from the efficiency of the computerized library management system. The system's ability to streamline processes would make it easier for the administrator to perform various tasks. The library system's improvement will fall short of both users' and administrators' expectations since it will present both opportunities and problems for the library. Therefore, the developed system helps both the users and administrators in navigating process and data analysis process instead of fully depending on manual work.

Keywords: Library, Management, Analysis, Development, System

1. Introduction

Library management system is designed to manage and maintain the records of the users in the library. Meanwhile, the library management system also used to manage and records all the movement of the books in the library. The library management system is a kind of system that connect the administrator and the users in the library. The system will provide various of functions to suit the needs of most of the users in the library [1]. The system comes with plenty functions but however it will be programmed according to the core functionality which is providing efficiency to administrator and users by enabling the administrator to check, display, modify, add and delete the data in the system.

In addition, the main purpose of library management system is to enable the operation of the library efficiently. The library management system is a user friendly system that involved in all the tasks and operations of library. For instance, the activities of borrowing books, stock checking, returning books, and so on. With the help of this system, the chances of errors and repetition of redundant manual works can be greatly reduced [2]. Moreover, the management of library via manual system required tons of labor work and immense amount of paperwork. With the usage and implementation of library management system, the needs for manual operation will be greatly reduce. A reduce in demand of

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manpower will cut off the operational costs. Therefore, the library management system also helps in cutting plenty of operational costs of the entire library.

Furthermore, the system deducts the time required for every operation and activities involved in the library. This is because the system provide ease to both the administrator and the users. For instance, the users can access to books available by just a click in the user interfaces. On other prospect of view, the system also provides a smooth and ease process for the administrator. This is because the administrator can provide answers and reactions to the queries from the other people. Such queries involved are the location of certain specific books, genre of books, category of books, availability of books and so on [3]. Implementing the library management system is certainly benefits to the library as it also comes with database that is required to add, delete, modify or edit the information of library. Therefore, plenty of process can be done with ease such as checking the information of users, validity of user account, register new account or cancel existing account. The computerized system saves times as compared with the manual functioned system. One of the most significant examples is the modification of books and checking the stocks of the books in the library. The library management system not only provide those mentioned benefits but also makes the entire operation of the library to be smarter and efficiently by having several of functions to be organized in a systematic way.

Based on the analysis and investigation carried out at the library that does not implement computerized library management system, it was found that there are plenty of critical issues remain unsolved. The library management team is still applying manual and offline-based form to manage those tremendous amounts of data. On the other hand, the administrator also does not provide with highly precise information to schedule the records of books borrowing and stock checking. One of the main problems is that most of the library located in primary schools, secondary schools, colleges, universities or even the public communities remain unadvanced and still does not or have not implement the latest computerized library management system due to some other reasons. This directly or indirectly taking too much of the time of everyone involved. It cannot be denied that every institution no matter secondary level or higher level such as universities should take initiative to invest and apply the computerized library management system [4]. Without the computerized library management system, it can be confirmed that the entire operation or processes in the library would be troublesome. This is because some of the operation such as entering data manually and writing records manually would take a lot of time. By using and implementing the library management system, all the tedious operations can be done rapidly just by a click of time. In fact, plenty of users and administrator found that it is difficult for them to search for certain specific books, journals and so on. Even though there are label on each of every row in the library, however, the books might sometime be replaced or misplaced no matter what reasons. Therefore, with the help of computerized library management system, the administrator can easily check the availability of books which eventually saves a lot of time for both the administrator and the users.

The main objective of the Library Management System will be overcome the problem mentioned in problem statement. To overcome the problems, the system is introduced to provide a better and alternative way to the library in addressing the problems. In addition, the Library Management System also intend to manage the data of the library such as the email address of administrator, password of administrator, username of user, password of user, address of user, contact number of user, email address of user, issues books, check the stocks of books, record the status of books, check the availability of books, record the borrow status and timeframe of books, list and display the history of records of books, and so on [5]. The system will manage all the obtained and saved information within the database. The system is predicted to provide usage for almost everyone involved in the library. Part of the system is built for administrative end and only the administrator is guaranteed to the access. Meanwhile, the system is also built for other users. The main purpose for doing this separated privilege is to ensure that the administrator can access the system thoroughly and the other users can only access certain part of the system. The product of the project is aimed to be an functionable program with the usage for reduce manual work in the library by managing the data and information via the computerized library management system.

The computerized library management system will be supreme to the uncomputerized library management system based on its efficiency and other improved operations. This system will be accessible via online and used for assisting administrator, and other users in maintain and managing the entire operations and activities occurred in the library. The system will also provide the fundamental features and functions of a library management system which included add users, delete users, update user's info, add new books, delete books records, checklist of books, check availability of books, update books information, update books availability, check location of books, manage registration features of newly registered users, and so on. All these mentioned specifications are the functional requirements of the system that based on the needs of each of every user that often use the system from high level of authorities to common users.

The expected result of the library management system will be creating several main classes [1]. The library management system is created based on several classes and sections that involved in the operation of the library. The main classes are administrator class and user class. The administrator class will be managing most of the operations in the library. Since the administrator is the one who grant most of the privilege of the system. They will be accessible to the entire functions of the system. For instance, by accessing the administrator account, the administrator can search for record, stock, and history of books that is saved for future use. The user class is created for managing the activities, operation of the users. The username, email address, password will be saved in the database to prove that they are recognized user of the library. The record of operation and borrowing history of the user will be saved and recorded for future use. The category class is created for administrator to look for books based on its category. The book will be classified under their category and this information is saved in the database. All the information is saved neatly and recorded for future use. The author class is created for administrator to look for books based on its author. The book will be classified under their author and this information is saved in the database. All the information is saved neatly and recorded for future use. The Location class is created for administrator to look for books based on its location. The book will be classified under their location and this information is saved in the database. All the information is saved neatly and recorded for future use. The book class will be managing all the action and operation regarding to the books. Each of the books will be recorded and classified based on the book information such as the genre, author, title, category, location, and so on. The library database class is created for controlling the database of the library. This class helps with detect and search for books rapidly. This can be done because the list of books is managed, stored, and classified based on certain arrangement and this make the information can be search easily by using the function. In addition, the information of books can be added, edit, remove, update, and previewed in the library management system.

2. Literature Review

The library is known as the brain of certain institution. The importance of having library to growth in the institute is undeniable. The esteem users of library which are the students play important character for the growth of library. The integrated library system which people also known it as the library management system is the main study of current project. The library management software is used to bring convenience to library operations. These conveniences including provide monitoring and controlling of transaction in the library [2]. A functional and useful library management system should be able to provide the features of library which are the borrowing features, recording features, and so on.

During the past and before the invention of computer, it was known that there are several different methods to save the records inside of the library. For instance, it was found out that people are likely to store the records up on the shelves. At the same time, the shelves are also labelled or marked alphanumerically to keep track of countless of book resources. In this way of saving the books, the book can be found and is available when any of the book is referred to the library manuscript. Thing changed when the invention of computer is successfully. Many researches tried and carried out different approaches to continue study the computerized library management system [3].

From another prospect of view, the library tasks prior to computerization was carried out independently and does not depending on another tasks. Meanwhile, the tasks can only be done by using manpower which will be needed in great amount since all the task need to do it in manual way. These manual tasks including from recording the registration status of students, recording the borrowing status of books, recording the availability of books, tracking the book location, and so on. The early of improvement to the library operation was merely the punch card system which allowed a better and efficient way to track the borrow status. However, other useful library services were still required plenty of evolution and still a long way to go. Since the punch card system is independent on other services, thus there was no other library operations was affected by this change. This is also caused by the other library operation and services are not been integrated yet.

2.1 Technique and Approach of the System

The technique and the approach of the system used will be the web-based approach. This kind of system is also known as the web-based system. The definition of the web-based application software is any program that can access over the network connection rather than just being stored locally on certain devices. Most of the web-based application software can be operated online via the web browser. On the other hand, the web-based application software can be made into client-based. Meaning that the small portion of the program needed to be downloaded on the client's desktop. However, the entire processes and background service is done on external server. The web-based application software in short is web apps. The web apps were likely to be used due to it is easier to set up and easier to create. These benefits are more likely to be demanded by the users as the web apps at the same time easier to maintain. On contrary, the traditional desktop software will be needed to install on the desktop locally. This kind of traditional desktop software can only be used in the computer which directly or indirectly restricted the choices of clients. Therefore, the web apps that can conduct entire operations and processes on the website or web browser will be more convenience.

Another technique and approach of the system used will be the web-based database. A web database is a database that may be accessed over a local network or the internet rather than having its contents saved on a desktop or associated storage. They are hosted on websites and are software as a service (SaaS) products, which means that access is supplied via a web browser. They are used for both professional and personal purposes. In addition, the MySQL is another approach used in the system. It is normally come together with the web databases. MySQL is also known as the Structured Query Language that is a relational database management system. The database management system is defined by the software that manages the movement of data around the database. The MySQL is one of the most famously used database management system based on some reasons. One of the reasons is it is an open-source system that is free to use and modify. In addition, MySQL is easily compatible with other platforms which make the installation at ease. The MySQL is also user-friendly that even someone who does not learn technology will be able to setup and use it straightforwardly.

The library management system comes with a functionable database and software to react with the database. Meanwhile, the graphical user interfaces (GUI) are also being used in the system. The computerized library management system is integrated by many of functionality. Therefore, it was known that the integrated system will separate software usage into other discrete programs which called it as the modules. The literature study of current or previous existed library management system can provide more reference in the system development process. The benefits of the existed system can be referred and implemented at the development phase.

2.2 Study of the Existing System

The study of the similar existing system is vital to the development of improved system. It can be act as the guidance or references while continuing develop the improved systems. At the same time, the feedbacks or reviews from user experiences of the existing system can come in handy and useful as it is able to provide a clear mind map for the developers to understand whether which functionality or system requirements need to be improved. The related information is vital for enhanced and improved

system development as it helps to eliminate those flaws and reduce the chance of getting any errors. Therefore, the research and study on existing system that related to the proposed system is inevitable. The related existing system are chosen base on their features and diverse of functionality. The aim of doing this is to get a clearer comparison between existing system and modify it to implement in the proposed system. Based on the study of existing similar systems, it can be observed that there are differences and similarities between the existing system and proposed system. The identified differences and similarities are as shown in Table 1 below.

Table 1 : Comparison Between Existing System and Proposed System

Features / System	KOHA	NewGenLib	Virginia Tech Library System (VTLS)	Proposed Library Management System
Login Function	Yes	Yes	Yes	Yes
Registration Function	Yes	Yes	Yes	Yes
Browser Compatibility	No	No	No	Yes
Database Server	No	No	No	Yes
Flexibility	Yes	No	No	Yes
Use Case	Public, School	Public Libraries	University Library	Public, School, Libraries, Institutions
Platform / Programming Language Used	PHP & Perl	Java	Java	Web-based

Based on Table 1, it can be found that most of the existing system and proposed system share almost the same features which are having the login module and registration module. However, when it comes to the browser compatibility, it is found that only the proposed system has such functionality. This is due to the existing system is software and need to be installed locally whereas the proposed system is web-based. Thus, the proposed system is compatible with any kind of browser such as the Internet Explorer, Google Chrome, Microsoft Edge, and so on. Another difference of proposed system with the existing system is that the proposed system uses database server to function well whereas the other did not use database server. On the other hand, the flexibility of proposed system and KOHA is good as compared to NewGenLib and VTLS. This is because NewGenLib are normally customized, modified and will be expanded to meet the requirement of the library and the patrons. The flexibility cannot be seen in VTLS because the source code of VTLS is kept confidential. The use case for existing system and proposed system are the same which include provide convenience to public, libraries, institution, and school. The programming language used to program KOHA will be PHP and Perl, whereas for NewGenLib and VTLS will be using Java.

The well-known and famous library management system is the KOHA library management system. It was known that the KOHA library management system is being used and implemented in 1999. Ever since then, the KOHA has been a demanding system by plenty of libraries worldwide. The improvement in functionality of KOHA, boosting the capability of the system. KOHA later release the newer version which is 3.0 in 2005. Zebra indexing engine integrated with KOHA and makes it a scalable solution and viable for libraries. Thereafter, the LibLime KOHA was introduced and it is built based on the previous foundation. The advanced feature set of the LibLime KOHA, make it to become the most functionally open source Integrated Library System in the market.

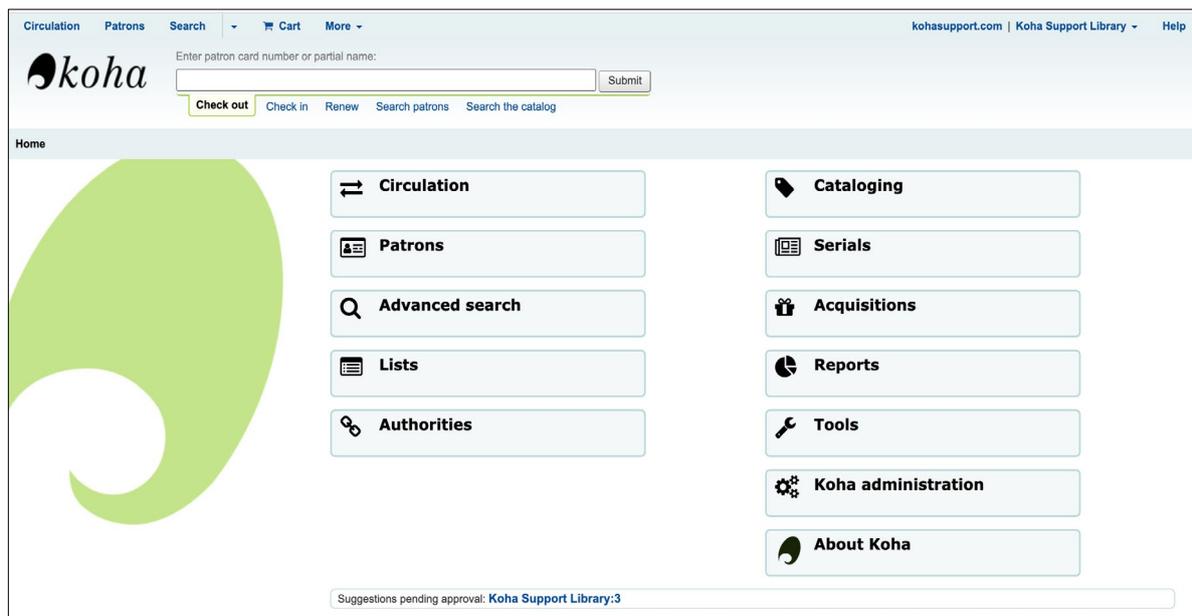


Figure 1 : KOHA User Interface (Vikas Singh, 2015)

Verus Solution Pvt Ltd created the NewGenLib, which is an Integrated Library Management System. Kesavan Institute of Information and Knowledge Management (KIIKM) provides the primary expertise. The location of the institute is Hyderabad, India. In March 2005, the initial version, NewGenLib version 1.0 was release. Verus Solutions declared NewGenLib as open source software under the GNU General Public License on 9th January 2008. NewGenLib 3.1 is the most recent version available on the market. NewGenLib is anticipated to be used as the major Integrated Library Management System by roughly 2500 libraries in 58 countries.



Figure 2 : Logo of NewGenLib (Vikas Singh, 2015)

The Virginia Tech Library System (VTLS) is a global leader in library automation, serving more than 900 institutions in 37 countries. VTLS has a deep and extensive understanding of the current demands of libraries and information centers as a provider of library solutions for more than 30 years. At the same time, VTLS is a trailblazer in producing cutting-edge products for the future demands of libraries. Virtua was the first Unicode-compliant Integrated Library Management System, as well as the first to include functional requirements for bibliographic records (FRBR) functionality and resource description and access (RDA) implementation.



Figure 3 : Logo of VTLS (Vikas Singh, 2015)

3. Methodology

The Waterfall Model is one of the most common used Software Development Life Cycle (SDLC). It can be found in many of the work field. The Waterfall Model is also referred as the linear-sequential life cycle model. This model is user friendly as it is easy to use and understand. There will be five phases in the Waterfall Model. Each of the phase is required to be completed before going on to the following phases as the phase goes on one by one and there will be no overlapping of phases. There will not be allowed for any phase to move on to the next phase if the current phase is not complete yet. These phases are analysis, design, implementation, testing, and maintenance.

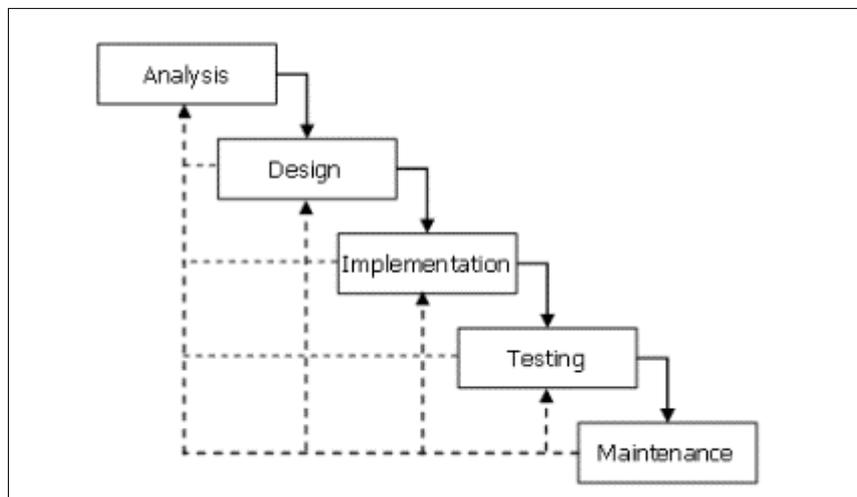


Figure 4: The Waterfall Development Model (Youssef Bassil, 2012)

The first phase which is the analysis phase is the phase where the requirement of developing the system is being collected and gathered. Later, the requirements to develop the system will be captured and documented in requirement specification document. Thereafter, when the requirements are confirmed, the next phase which is the design phase will take place. The second phase which is the design phase is the phase that identify the approach for the system. The requirement specification from analysis phase are bring into the design phase. The system design will be ready after the information from analysis phase are studied. In addition, the system design will help in specifying the software, hardware requirements and the system requirements. These requirements are needed to define the entire

system architecture. The third phase which is the implementation phase is the phase that receive and gather the inputs from design phase. Then, the system will begin with the development, but the development will be done in small units which is also the fragment of the program. The fragment will be later integrated at the next following phase. Thereafter, the small units will be undergoing the unit testing to test for its functionality. The fourth phase will be the testing phase. In this phase, the system will be tested many times to ensure the system fulfill its functionality. All the entire system is tested to detect for any failures and faults. If there are no errors or problems found, the system is considered done and ready to be marketed. The fifth phase which is the last phase will be the maintenance phase. This phase is required in the system development because there will always be some minor problems or issues which come up at the client environment. These issues including the bugs and so on. To overcome those issues, the patches are released after the deployment of the system to enhance the product to better versions. Therefore, there will be a regular of update and patching for the system to make sure the quality and functionality of the system is achieved.

4. System Analysis and Design

The system analysis is a vital part in the system development. This is because it involves with the entire process of evaluation of the user's expectation towards the system. In order to achieve the target which is develop a fully functional system that bring efficient to the users, the aims and purpose of system development will be required to prioritize at the first place. From another prospect of view, the system analysis can also be defined as an approach that solve problems and bring solutions to the users or even the organization. Thus, system analysis is an approach that constructs the system from its components and later examine how the components can interact between each other and operate well to fulfill the initial goals.

4.1 UML Class Diagram

The class diagrams are one of the object-oriented approaches that show the relationship of the system by the view of building blocks [4]. The class diagram shows the classes in the system together with the attribute and operations of each of every class. The relationship between the classes are also explained here in the diagram [5]. In common diagram, each of the class will consists of three parts which are the name, attributes, and operations. The main classes of the Library Management System include the Library Database Class that is the core part of the designed system that used for database. In addition, the General Management Class which is the basic building block of the system that used for managing general information of books. Moreover, the user Class that use by the normal user class in the system to aid with borrow of books. The Administrator Class that have the highest authority in the system that able to search for private and confidential data. The Calculate Fines Class which mainly used to issue penalty to user who violate the rule and regulations. The Book Records class that used to add in, remove, or edit the books in the system. The Book Management Class that used to manage all the books in the library. The Book Issuing Class that designed for borrow of books via the system.

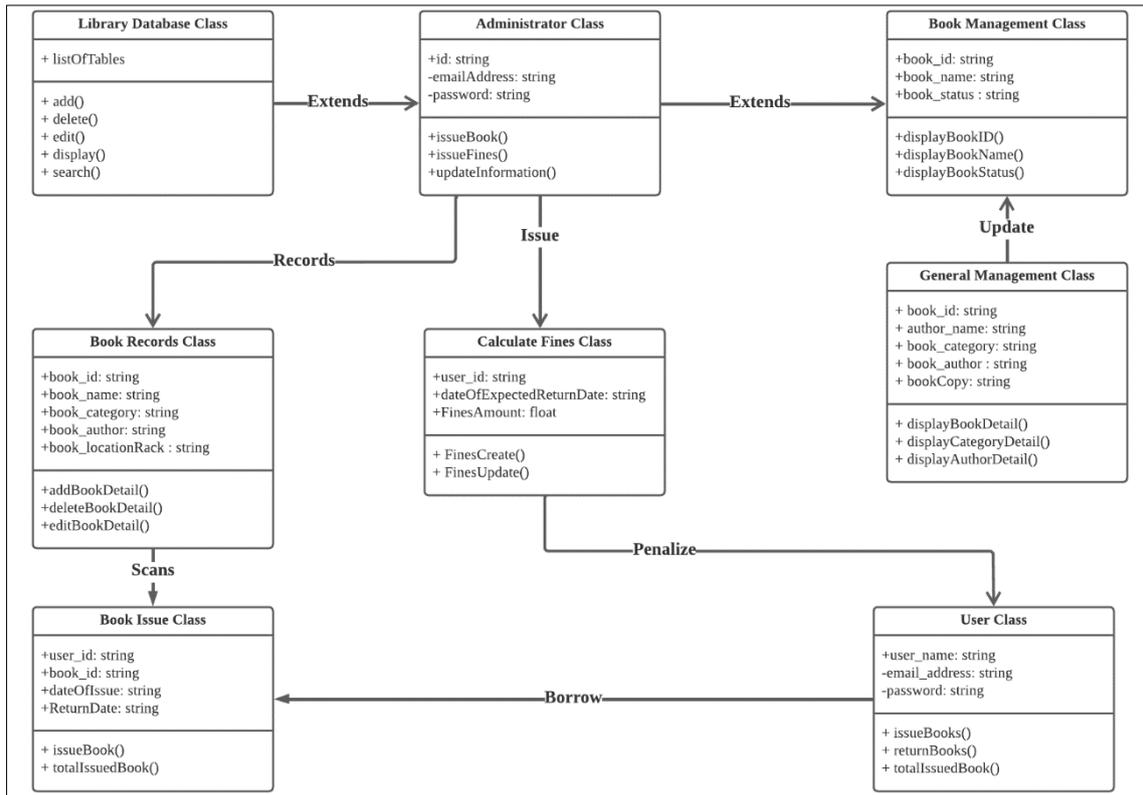


Figure 5: UML Class Diagram (Y.R. Tong, 2022)

4.2 Use Case Diagram

The use case diagrams can be defined as the behavior diagram or model that used to show the relationship and interaction between the system and the users. It shows different action and approaches in the system to produce the output or illustrating the process of the system. At the same time, use case diagram provide a graphical overview of the actors involved in the system. Therefore, there will be several functions that carry out by the actors. This diagram is one of the most commonly used diagrams because it can easily identify the main actors involved in the main processes of the system. There will be two main actors in the system and the other will be use cases. The administrator that mainly responsible for maintaining the system by adding, deleting, and editing the records of books. The administrator can issue penalty to user that violate the rule by returning the book after due date. Administrator also responsible for checking on the book records, checking the availability of books, and process the book issued of users. The user responsible for checking on the availability of books, issue process of book borrowing, and return the books. As for the use case, there will be Add book in the records which used to add a new book on the current database system. In addition, the remove book in the records that used to remove a book from the current database system. The Edit book in the records that used to modify and edit the book information from the current database system. The Register new account that used to add a new account and register in the library management system. The Issue book that used to borrow the book from the library. The Return the book that used to return the book to the library which was issued to a user.

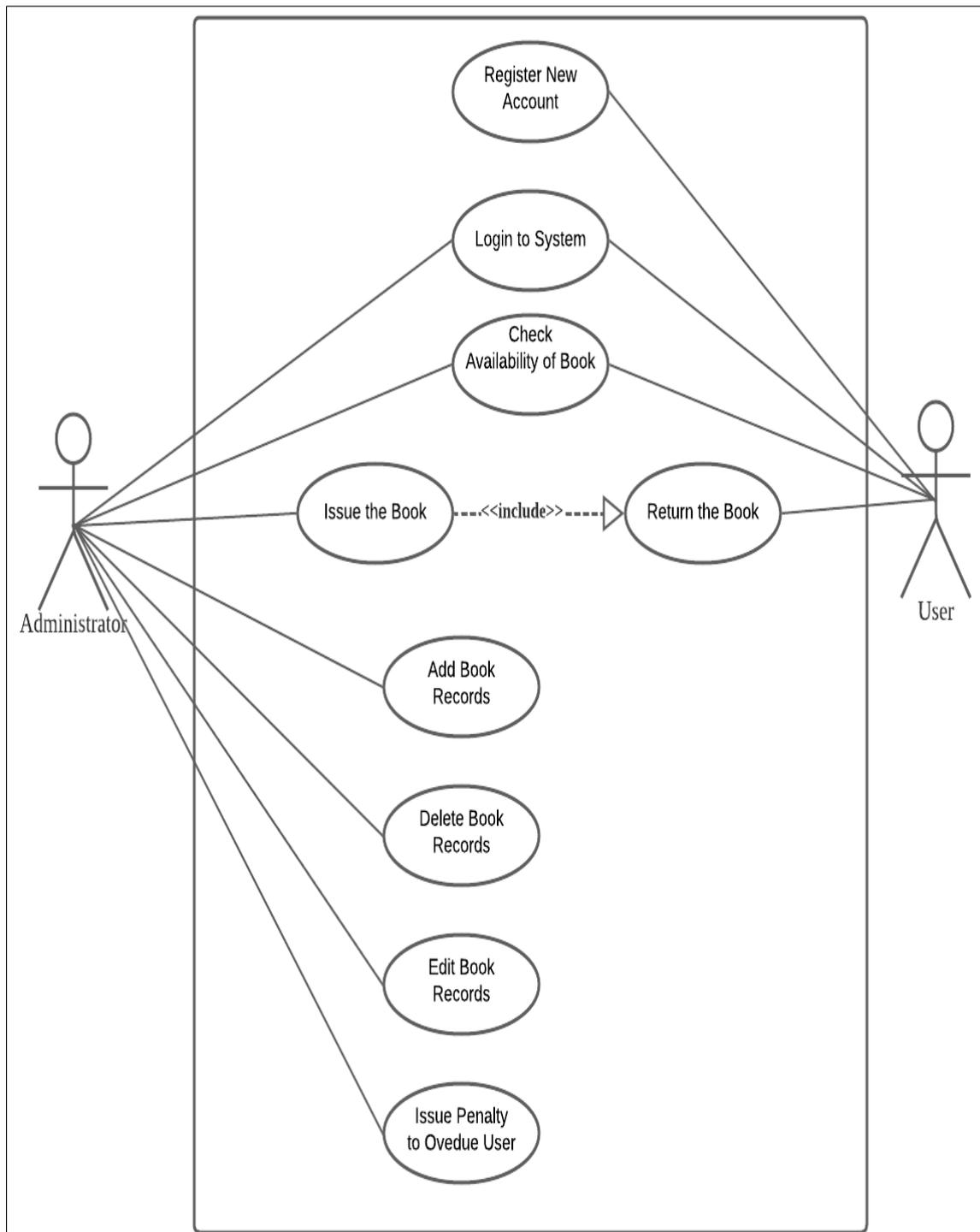


Figure 6: Use Case Diagram of System (Y.R. Tong, 2022)

4.3 System Flowchart

The system flowchart act as the graphical and visual representation of the function in the system. Meanwhile, it also shows the mind of developer by explaining the solutions to the problem stated. The most difficult process can be easily understood by providing the flowchart of the system. This indirectly and directly make system flowchart to be the first thing to do before beginning to develop the system. The reason behind is because flowchart can act as a blueprint for the system development and thus it is most preferable by developer and programmer. The following Figure 7 will show the system flowchart of Library Management System.

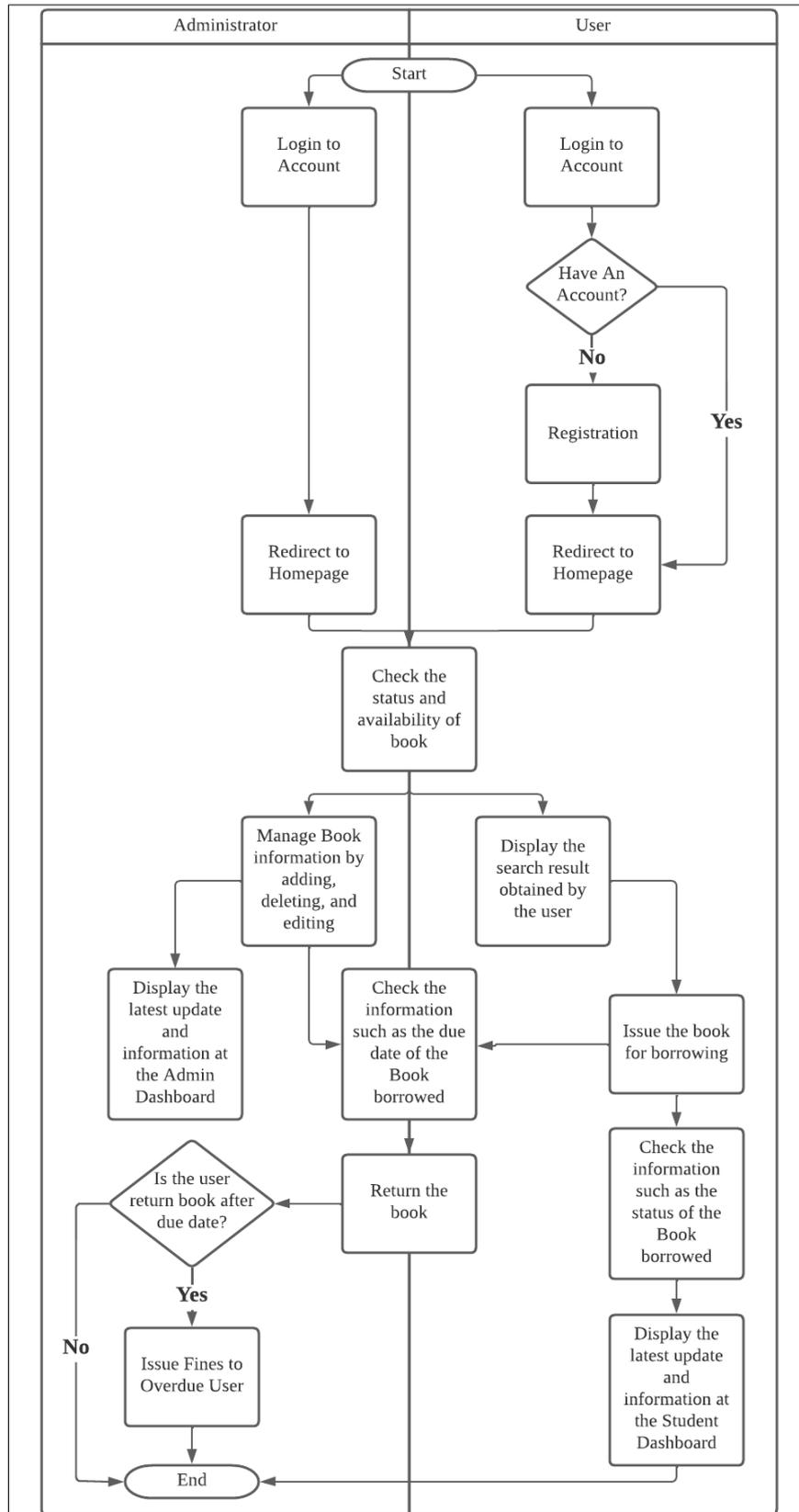


Figure 7: System Flowchart

4.4 System Design

To ensure that the several software can function well together, the web-based system design and architecture will be created. The purpose of creating web-based system design and architecture will be aimed to provide a better understanding for user and developer when using the system. The system design for the library management system will consist of graphical user interface, databases, and middleware systems. For a proper functional web-based system, there will be codes running at back-end by using Visual Studio Code. In addition, XAMPP control panel will acts as the database system and the front-end will be the browser (Google Chrome or Mozilla Firefox) that response to user input

4.5 System Architecture

Figure 8 will show the system design and architecture of the library management system which aids in understanding how does the system work in back-end and front-end together with several software.

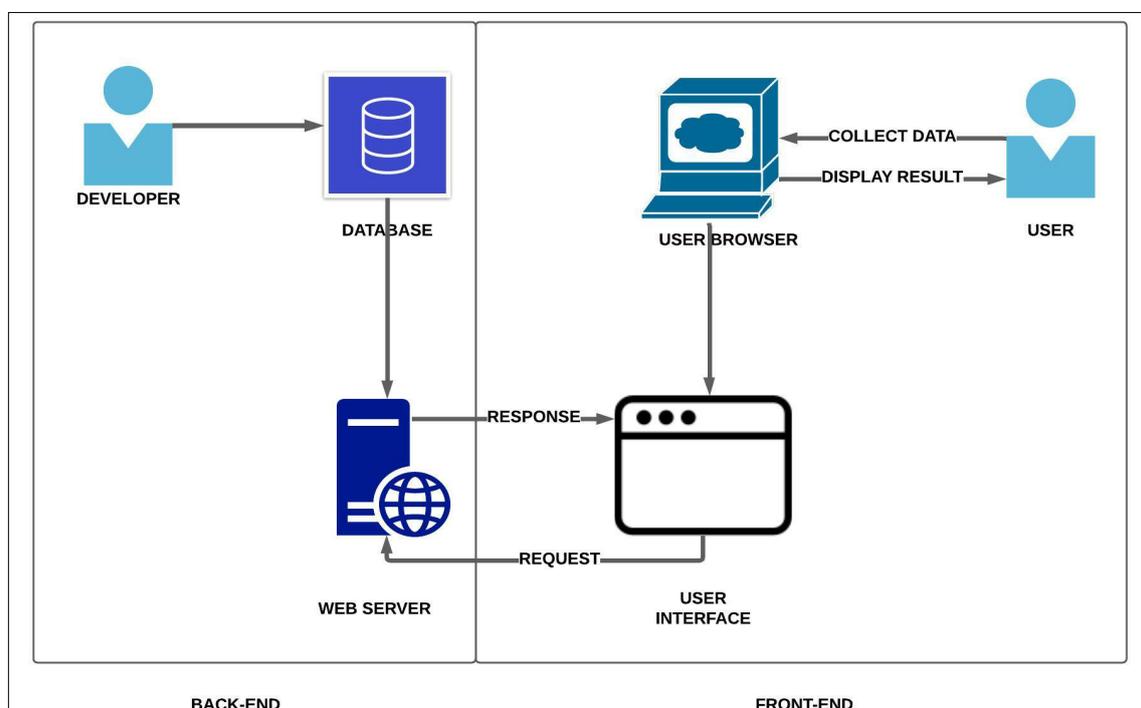


Figure 8: System Design and Architecture (Y.R. Tong, 2022)

4.6 Database Design

The database is an effective and useful tool to perform highly accurate and precise computer activities. These includes the presentation of program data, modifying and alteration of program data, and storing of program data. Database design also be defined as the accumulation of function and process that hasten the system development phase such as the planning phase, design phase, implementation phase, testing phase, and maintenance phase. All these phases are involved in the current library management system [6]. The database design for the library management system is aimed to automate the operation in the library such as searching for books, updating book records, issue book and so on.

On the other hand, a well designated and greatly functionable database will cut down the cost of operation and maintenance. At the same time, it also helps to enhance the accuracy of obtained data and consistency of data. In other word, well-built database will improve the effectiveness when tackling problems as it is able to provide proper solutions. The entire operational costs of the database are highly related to the overall performance of database system. Hence, the database design is a key point that should not be overlooked. The database design is made with the purpose to build the logical and physical models of the database system [7]. Meanwhile, the logical model is highly dependent on the requirements of data usage. Therefore, plenty of considerations are required to figure out before the database designation. On contrary, the physical model consists of physical data that is independent to the physical conditions. The physical model of database is designed based on the logical model of database. This is because the physical model will inherit the translation of logical model together with the help of software system and hardware resources to grant the control of the database system.

Conclusion

The library consists of pool of sources of knowledges and information. This has made the library a well-made environment and community provided to readers, students and so on. All these reading atmosphere and limitless resources has certainly interested the readers [8]. The attraction to them might due to the convenience of searching for limited edition books, borrowing books, reading and access to journal, and so on. The computerized library management system hastens the stereotype and typical procedures of library. It also able to bring convenience to administrator and users. With the implementation of the computerized library management system the consistency of the record will improve the quality of the records produced based on the activities and operations of the library. The average performance and the entire process of operation would be improved. The developed system will bring benefits to the library as technology is evolving the world. The improvement on the library system will certainly overturn the expectations of library users and administrator as the improvement would bring both the challenges and opportunities to the library. As a result, the computerized system helps to manage the library thoroughly as it eliminates the needs of manual process by issuing books in a simplified way that save time and effort.

The computerized library management system that has been developed has multiple advantages which included the system required the user to be registered first before login the system which means only the authorized users can have the privileged to login to the system. By having this will indirectly enhance the security level of the system. At the same time, this is vital to prevent the privacy of the library system. When unauthorized user tries to login to the system, a message will be shown to alert them. This will help them understand better to the system which the users must create an account first prior to login to the system. In addition, the system is now able to provide precise and detailed information on the books records, history, and general information such as the category of the books and the 85 authors of the books. The user can proceed to search tab to look for any desired books that they want to. Based on the capability of filter key point or keywords upon searching the books, the entire process can be carried out easily and rapidly by both the user and the administrator. Meanwhile, the preciseness and accuracy of searching book is also improved and enhanced by the function of saving and recording the data in the database. Moreover, the system is now able to bring awareness to the user by having the penalty for user who did not obey the rules and regulation of the library by returning the book issued after the expected returning date.

However, the system is not considered as flawless system as there are some improvement or updated required to be done prior to the system update in the future. These is because there are some limitations to the current system. For instance, the proposed computerized library management system does not provide the user support such as the chatbot, customer service, or helpdesk. There will be no such convenient available to provide answer and solution or to provide help to the user of the system. In addition, the user is not able to approach to any live agent to help them when they are facing with trouble. In addition, the user interface of this system only suitable for certain size of screen resolution in the internet browser. Moreover, the system registration requirement for user photo only accept

specific and certain size of the picture. It is even restricted to only accept few kinds of file type, for instance jpg file.

As for the future scope, it is aimed to increase more functional facilities and add on more features available to provide help to the user. In addition, it is even aimed to provide audio features to the user such as searching for book based on voice which might be increasing the interaction between the human and computer and thus making the system much more user friendly and fulfill every user requirement and needs in the best way. For the future enhancement, the system should modify to be able to accept more kinds of the file type and file size required by the user during registration step. Moreover, the system should be improved by providing new features such as providing chatbot or live customer service support to the users whenever they are in needs of help.

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