

Digital Library Application Design

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Abstract— The Covid-19 pandemic has had a positive impact on technological developments. Various software developed massively to support various activities in various organizations. The campus which is the center of education also combines various applications to support the teaching and learning process. One of them is a library application. This study aims to design a digital library application to support the provision of literature for students and lecturers on a campus. research methods follow the rules of the Software or System Development Life Cycle. The design results can be a reference for developing digital library applications.

Keywords— Digital library, learning, literature, pandemic.

I. INTRODUCTION

The positive impact of the Covid-19 pandemic is increasing the technological literacy skills of almost all peoples [1] [7]. The teaching and learning process on campus has also turned into virtual meetings using video conferencing applications such as Zoom, Google Meet, Microsoft Teams, and using the Learning Management System (LMS) application. The Covid-19 pandemic is the right moment to improve the education ecosystem including the availability of digital library resources by campuses. Students need literature to do their coursework and work on their thesis. Lecturers also need literature to prepare lecture materials and for research. To make it easier for students and lecturers to find literature, campuses must provide access to digital libraries [1].

Digital library is a library that has a collection of books in digital format and which can be accessed with a computer or mobile device. Digital libraries are different from conventional libraries in the form of a collection of printed books, micro films (microform and microfiche), or a collection of audio, video cassettes, etc. The contents of the digital library are on a server computer that can be placed locally, or at a remote location, but can be accessed quickly and easily via a computer network. Can use the intranet network or the internet. In the digital era, library services have developed rapidly by using information technology [2].

Software development follows the rules of the Software or System Development Life Cycle (SDLC). SDLC is a stage of work that aims to produce a high quality system that is in accordance with the wishes of the customer or the purpose for which the system was made. In software engineering, the concept of SDLC underlies many types of software development methodologies [3][5]. These methodologies form a framework for planning and controlling the creation of an information system, that is, the software development process [3]. The software or system development life cycle is shown in Figure 1 [3].

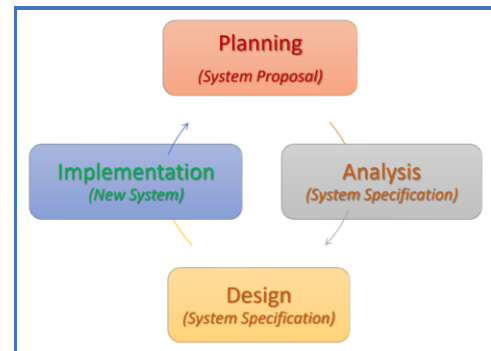
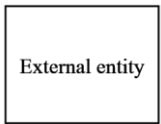
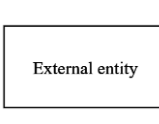


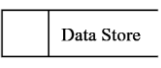
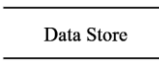
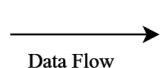
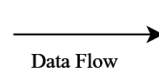


Fig. 1. Software or System Development Life Cycle.

Software development is divided into two approaches, namely the structured approach and Object Oriented Design (OOD). The structured approach represents the system based on data and the processes imposed on that data. The modeling tools used are Data Flow Diagrams (DFD). The object oriented design approach sees the system as a collection of objects consisting of data and processes. Modeling tools used Unified Modeling Language (UML) [3].

A data flow diagram (DFD) shows how data moves through a process or information system. Information regarding the input and output of each of these processes is present in DFD. DFD also performs a number of other tasks, including modeling, describing systems, and communicating system design.

TABLE I. DFD Notation

Gane or Sarson	Yourdon or Coad	Description
		Represent people or organizations outside of the system
		Represent either a whole system, a subsystem, work being done, an activity
		A computer file or database, a transaction file, a set of tables, a manual file of records
		Data flow shows the data about a person, place, or thing that moves through the system

Data flow diagrams are frequently used to support application developers, particularly when creating an information system. In 1970, Larry Constantine and Ed Yourdon made DFD well known [4][6]. Additionally, the SADT (Structured Analysis and Design Technique) classic text contained the diagram for the first time. The notation in the data flow diagram also refers to the graph theory which was originally used to model the workflow of an organization.

Data flow diagrams have two main types of notation used for data flow diagrams are Yourdon-Coad and Gane-Sarson, both named after their creators, all experts who helped develop the DFD methodology: Ed Yourdon, Peter Coad, Chris Gane and Trish Sarson. There are some differences in style between the notation types [4]. A comparison of the two types of notation is shown in table 1.

II. METHODOLOGY

The research begins with conducting a literature study using both books and journals related to the research title. The research method carried out by the author is shown in Figure 2 below:

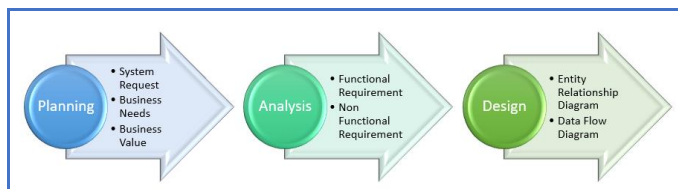


Fig. 2. Research methods

In the planning phase the researcher determines the system request, business needs and business value. Furthermore, researchers identify the problems. After the planning phase is complete, the researcher continues the analysis phase. In this phase the researcher determines the functional requirements and non-functional requirements. After the analysis phase is complete, the next step is for the researcher to design a digital library application. In this phase the researcher made data modeling, namely entity relationship diagrams (ERD) and Data Flow Diagrams (DFD). ERD and DFD are designed based on the functional requirements that have been determined in the analysis phase.

A. Planning Phase

In this phase the researcher determines the system request, business needs and business value. System Request: as a result of the world experiencing the covid-19 pandemic situation, changing the way people and organizations carry out their activities. Therefore, the library manager wants to create a digital library system so that it can be accessed online.

Business Needs: this application is built for the needs of literature for students and lecturers. Literature is needed to prepare teaching materials, for research or final assignments and to work on college assignments.

Business Value: this application will reduce the cost of place, librarian and administration costs.

B. Analysis Phase

In this phase the researcher analyzes the system requirements, which consist of non-functional requirements and functional requirements.

This web-based digital library application has non-functional requirements which are divided into three parts, namely:

1. Operational Needs

The application requires a server or hosting provider so that it can be accessed via the internet network, the MariaDB database management system.

2. Performance Requirements

Response time is less than 20 seconds when users access the main page and access features in the application.

3. Security

Only admin can activate membership data. Only admin can deactivate membership data. Only registered users can access the system.

For the functional requirements of this web-based digital library application, it is divided into three parts, namely:

1. Manage Data

Admin can perform CRUD (Create Read Update Delete) operations on eBook data, Author, Publisher, Category.

2. Membership

Admin can perform membership activation operations and deactivate member data. Members (students and lecturers) can log in, view eBook lists, search for eBooks and read eBooks on the system after membership is activated. Users (students and lecturers) can update personal information and change passwords after logging into the system. Users (students and lecturers) cannot log in to the system after membership is deactivated. Membership will be deactivated if the following conditions are students with leave status, students with drop out status or resign, students who have graduated. Lecturers who are no longer active on the campus

3. Academic Data

Data on students, lecturers and majors are taken from the Academic System

C. Design Phase

Based on the functional requirements that have been made at the analysis phase, the researcher makes a data modeling design and data flow diagram. The first thing to do is create an ERD. The resulting ERD design for digital library applications is shown in Figure 3.

In Figure 3 below, the relationships between entities for creating digital library applications are shown. The cardinality of the category entity with the eBook entity is one to many. So one category has many eBooks. The author can be used as a multivalued attribute, because one eBook can be written by several authors. So because the attribute is made multivalued, the cardinality of the author entity and the eBook entity is one to many. The cardinality of the publisher entity with the eBook entity is one to many. One publisher can publish many eBooks. Librarian has no relationship with other entities. The member entities come from the lecturers entity and students entity, and each has one to one cardinality. This means that one member is exactly one student or one lecturer. Lecturers

and Students entities are entities that exist in the academic system.

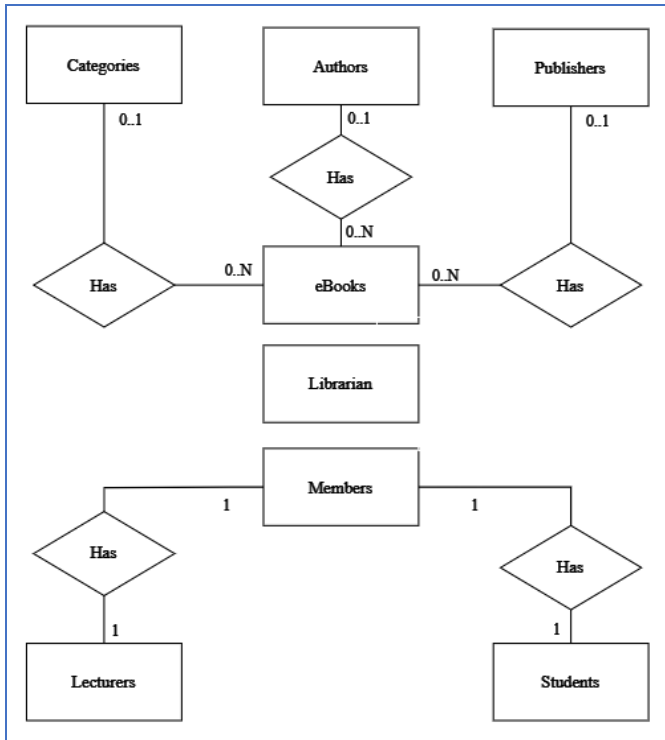


Fig. 3. Entity Relationship Diagram

The next step is to create a data dictionary. To explain each entity in Figure 3 above, attributes are given. The data dictionary is presented in table 2-7 below:

TABLE II. Members entity attributes

Attribute	Data type	Description
NIM/NID	Char (10)	Primary key
Password	Varchar (256)	The password must be hashed
Fullname	Varchar (60)	
Email	Varchar (30)	
Status	Enum	Active Non-active

The Members Entity has five attributes. This entity will be used to store member data from digital library applications. Members consist of students and lecturers who come from the academic system.

TABLE III. Librarian entity attributes

Attribute	Data type	Description
ID	Int (11)	Auto increment, Primary key
Password	Varchar (256)	The password must be hashed
Fullname	Varchar (60)	
Email	Varchar (30)	

The Librarian entity has four attributes. This entity will be used to store librarian data. The librarian has the role of managing member data and eBook data.

TABLE IV. Categories entity attributes

Attribute	Data type	Description
CatID	Char (5)	Primary key
Categories	Varchar (50)	Categories name

Category entities have two attributes. This entity will be used to hold eBook category data. Categories are required for easy search.

TABLE V. Authors entity attributes

Attribute	Data type	Description
AuthorID	Char (5)	Primary key
Fullname	Varchar (50)	

The Authors entity has two attributes. This entity will be used to hold the eBook author's data.

TABLE VI. Publishers entity attributes

Attribute	Data type	Description
PubID	Char (5)	Primary key
Name	Varchar (50)	Publisher name
City	Varchar (30)	The city or location of the publisher

The Publisher entity has three attributes. This entity will be used to store eBook publisher data.

TABLE VII. eBooks entity attributes

Attribute	Data type	Description
ID	Int (11)	Auto increment, Primary key
ISBN	Char (13)	
Title	Varchar (50)	The title of the eBook
CatID	Char (5)	Foreign key
AuthorID	Char (5)	Foreign key
PubID	Char (5)	Foreign key
Cover	Varchar (40)	eBook cover
File	Varchar (40)	eBook File
Year	Year	Publication Year

The eBook entity has 9 attributes. This entity will be used to hold eBook data. In this entity there is a foreign key that comes from another entity. The relationship between entities has been shown in Figure 3 above.

After determining the Entity Relationship Diagram, the next step is to create a context diagram. The digital library application context diagram is shown in Figure 4.

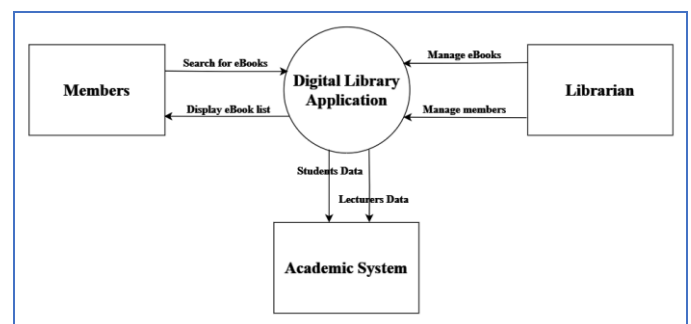


Fig. 4. Context Diagram

Figure 4 above shows that the digital library application has three external entities. Members as external entities, access the system for the purpose of searching eBooks. Then the system will display a list of ebooks to members. The external librarian entity accesses the system to manage eBooks and members. Members of this digital library application are lecturers and students from external entities of the Academic system.

The next step is to create a zero level Data Flow Diagram. At this phase the researchers identified all processes that occur in the system, all external entities, and data store. The processes that occur and data flow at this level are shown in Figure 5 below:

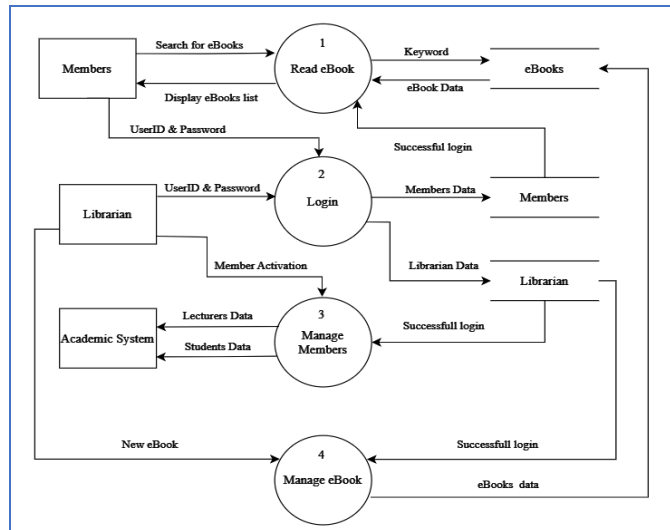


Fig. 5. DFD Level 0

The first process is reading eBooks, the second process is logging in, the third process is managing members and the fourth process is managing eBooks. The process of reading an eBook has three inputs and two outputs. When member search for eBook, the search process will search for eBooks based on keywords in the data store. Search results will be displayed to members.

The login process has two inputs and two outputs. This process is accessed for the first time by members and librarians. The userid and password data will be matched with the existing data in the library and members data store. After the member has successfully logged in, the member can do the book search process. When the librarian successfully logs in, the librarian can manage members and manage eBooks.

The process of managing members has two inputs and two outputs. Lecturer and student data are taken from the academic system. Then it is activated by the librarian.

The process of managing eBooks has two inputs and one output. The librarian enters new eBook data and then saves it in the eBooks data store.

The next step is to break down the processes in the zero level DFD into a more detailed diagram, which is called the level one DFD. DFD level one is shown in Figure 6 to 9 below.

The process of reading an ebook is break down into two more detailed processes. Before members read eBooks, members will search for eBooks first. Search usually uses keywords. The search results are in the form of a list of ebooks that match the search keywords. Furthermore, if members find an appropriate title, then members can read the eBook.

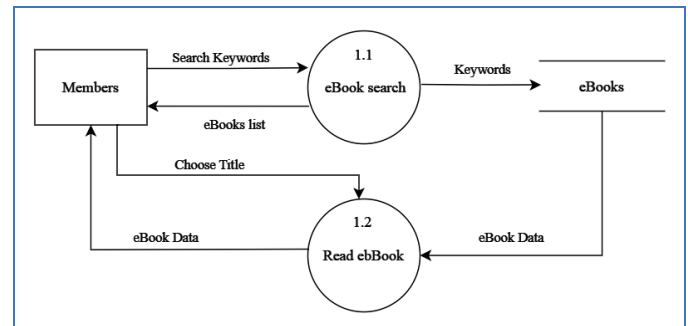


Fig. 6. DFD Level 1 for the process of reading eBooks

The login process is also divided into two processes, namely the login process and the verification process. When users (members and librarians) enter a userid and password, a verification process will occur. This process matches the userid and password stored in the member's or librarian's data storage. If it matches, the system will display the member area or admin area.

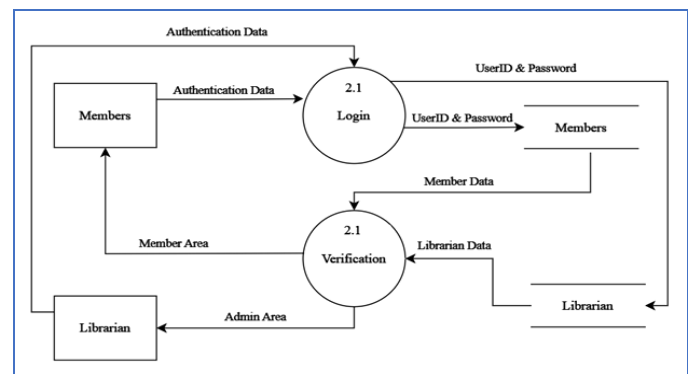


Fig. 7. DFD Level 1 for the login process

The process of managing members is also divided into two processes, namely search lecturers or student data and activation. The activation process is carried out by librarians, but librarians must first search for lecturer or student data in the academic system. After activation, the lecturers or students data is stored in members data store.

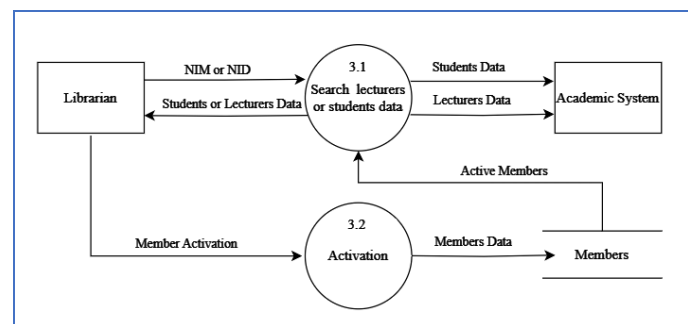


Fig. 8. DFD Level 1 to manage members

The process of managing eBooks is divided into four processes, namely Manage Publishers, Manage Categories, manage Authors and manage eBooks. All processes are managed by librarians.

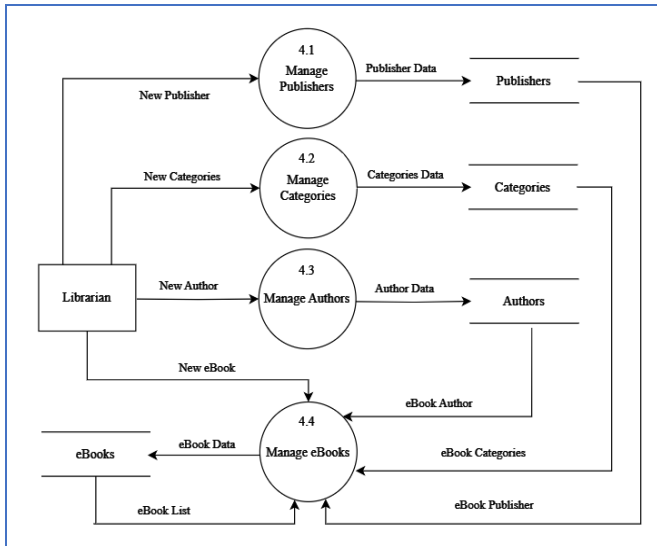


Fig. 9. DFD Level 1 to manage eBooks

III. RESULT AND DISCUSSION

This research produces a design for the development of digital library applications. There are two things to do at the design stage, the first is to make an entity relationship diagram that is equipped with a data dictionary, the second is to make a data flow diagram. Figure 3 shows 8 entities. To build a digital library application requires at least 6 new entities instead of 8 entities. This is because the lecturers and students entities are entities that are in the academic system.

The digital library application has three external entities, namely Librarian, members and academic system. In the zero level Data Flow Diagram, four processes are determined. The four processes are Read eBook, Login, Manage Members and Manage eBooks. In the data flow diagram level one, all processes are divided into more details. The Read eBook process (fig. 6) is divided into two processes, namely the eBook Search process and the Read eBook process. The Login

process (fig. 7) is also divided into two processes, namely the Login process and the Verification process. The third process is Manage Members (fig. 8) which is divided into two processes, namely Search lecturers or student data and Activation. The fourth process is Manage eBooks (fig. 9) divided into four processes namely Manage Publishers, Manage Categories, Manage Authors and Manage eBooks.

IV. CONCLUSION

Digital library is an application needed by students and lecturers to support the teaching and learning process and research. After the Covid-19 pandemic pushed conventional libraries to change business processes in serving students and lecturers in terms of providing literature. This research can be a reference in developing digital library applications. This research needs to be continued for the mockup and construction phase.

REFERENCES

- [1] Ridha, Ester, Poltak, "Prototype of Digital Library Application Using Microframework Flask" *Journal of Computing and Information Technology*, p. 96, 2022
- [2] J. Dubey, "Digitalization of Library: An Overview," *International Journal of Library and Information Studies*, vol. 10(3), no. Jul-Sep, pp. 195-199, 2020.
- [3] Dennis, Alan, "System Analysis & Design An Object Oriented Approach with UML", Fifth Edition, Indiana: Wiley, 2015.
- [4] "Data Flow Diagram Symbols" Lucidchart [Online]. Available: <https://www.lucidchart.com/pages/data-flow-diagram/data-flow-diagram-symbols>. [Accessed 12 6 2023].
- [5] Kendall & Kendall, "Systems Analysis and Design 9th Edition", Prentice Hall, 2013.
- [6] Ian Sommerville, "Software Engineering Ninth Edition", Addison-Wesley, 2011.
- [7] Valendra, Dzikria, Latifah, Nabila, Nanda, Dewi, Noor " Dampak Positif Pandemi Covid-19 di Lingkungan Pendidikan Tinggi:," *Edukatif: Jurnal Ilmu Pendidikan*, vol. 4, no.5, p. 7042, 2012.