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Library Management System Integrating Servlets and Applets Using SQL Library Management System Integrating Servlets and Applets Using SQL database

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Introduction

Servlets and Applets make it very functional to integrate in library management systems to enhance the modernization of library functionalities. Servlets are Java programs that are located in the server side of the network that helps in handling clients' requests and responses while applets are Java programs that are located at the client side of the network that helps in improving the interfaces. These with an SQL database can be used effectively to store data by updating the data in real-time saving time on a lot of processes.

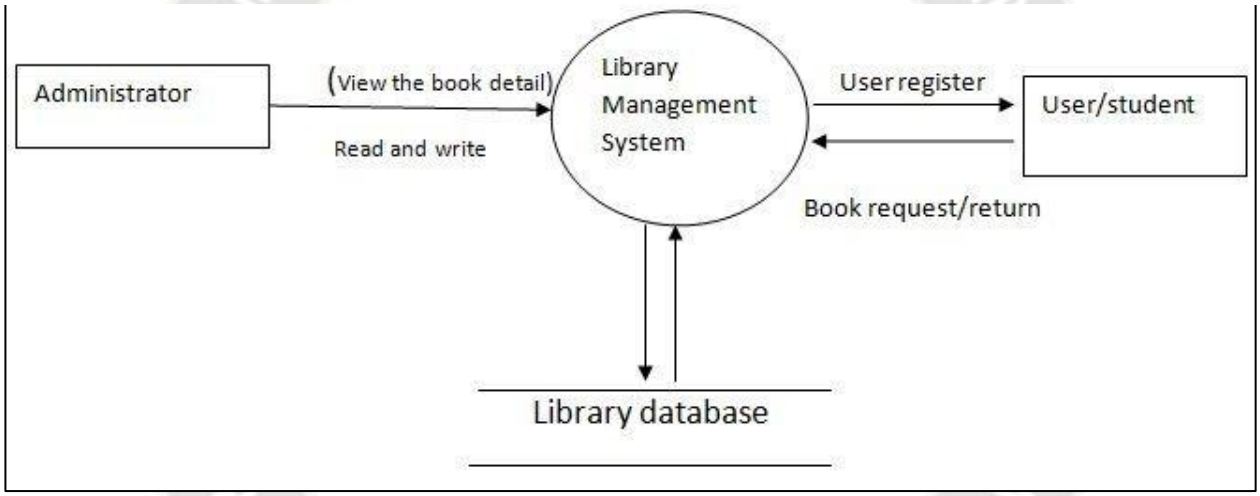

Figure 1: Library Management System Architecture Diagram
(Source: https://www.studentprojectguide.com)

These are some of the concerns that have been addressed in this report through a design and implementation of a library management system that involves use of servlets, and applets with an SQL database. Therefore, the major goal entails designing a system that addresses book catalog, client accounts, and borrowing systems. It believes that it is very important because it helps to make library functioning better by minimizing the role of people's mistakes and offering good navigation through the libraries' resources for both libraries' staff and readers.

Literature review

Technologies Involved: Servlets, Applets, and SQL Database

According to Qu 2021, Servlets are Java based reusable and robust software components that process the client request on server side and return dynamic web content back to the client. Due to their efficiency and scalability, they are well utilized in web applications. Servlets can compose, retrieve and even calculate data from the databases as well as respond to the client inputs that it receives. Applets, on the other hand, are Java programming language applications which can be embedded in a web page on an intranet and in a web browser on a client computer. The use of applets in a library management system can help to improve the appearance of the management system by making the library system more

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user friendly. Structured query languages which are referred to as SQL databases are used to store and manipulate structured data securely. In an LMS, an SQL database can be used to store information concerning books, users, borrowing activities, etc. SQL databases integrated with servlets and applets can be used to conveniently obtain the pertinent data, make changes and manage them.

Review of Existing Systems

According to Rafique *et al.* 2020, Most of these systems are a blend of several technologies in order to offer the users effective solutions. Other systems are developed based on the open-source architecture that make them flexible and easy to modify. These systems frequently mean a relational database, which could be MySQL and/or PostgreSQL and other similar ones to store and manage data. Compatibility with web technologies for developing java servlets and applets offered by these systems makes it possible to deliver a seamless user interface. However, most of them present problems with scalability and performance. Since such systems are centralized, as the size of the libraries grows, or the number of the users using the given systems grows, it is possible to face issues such as slow performance or system crashes. Moreover, many of these systems lack appropriate mobile interfaces and compatibility so people who use portable devices such as smartphones and tablets have restricted access to the systems.

Integration of Servlets and Applets in Database Management

According to Ma *et al.* 2019, the use of servlets and applets along with SQL databases facilitates the implementation of library management systems. Servlets may be employed in responding to users' requests, accessing the database, and constructing the responses on the server side. This indicates that applets can be used at the client-side since they help in availing interactive tools and real time updates. This integration also proves beneficial because servlets can directly be in touch with the SQL database to both gather and store information. They are real time operations where users can search books, check their account status or borrowings among others. By adopting applets, the platform achieves a good user interface and the applets are capable of running smoothly on low processing machines.

Challenges in Library Management System Implementations

According to Padhi and Nahak 2019, In spite of the benefits, which have accrued from the use of the servlets, applets and SQL databases, there are always challenges, which are associated with the integration of such technologies in the management of library systems. Arguably, one of the most important issues is maintaining compatibility across the devices and browsers. Java applets may however face certain compatibility problems with the advanced web browsers since they do not fully support the applets.

Another challenge can be considered the problem of data security and their confidentiality. Some of the library management systems contain personal information belonging to the users such as accounts details, borrowing records etc. Where and how it is stored is important but more important is making sure that it is not accessible to wrong hands. Security measures such as encryption of data and security on who has access to the data is important when designing and deploying the system.

Last but not least, there is the issue of scale up that is being experienced by most modern firms. Besides, since the number of users and amount of data in the Library management system increases, it is important that the system be scalable. This implies that proper design and configuration of the system have to be made in a way that the system can scale up for the escalating loads.

Methods

System Design and Architecture

The architecture of the library management system entails the development of a system structure that incorporates the use of servlets, applets, and a database that uses SQL. The system architecture is divided into three main layers: client side, or also known as the presentation layer, the middle code layer or the business logic layer and the data layer. The presentation layer covers the interaction with the user by the means of applets and supports the user in the way that he/she can find the resources of the library easily (Mandal 2019). Servlets perform the duty of managing the business logic layer, they receive the user's request and compute the necessary information together with interacting with the data layer. This layer is SQL database layer where all library related information like book catalog, user profile, borrowing record etc. are stored and which is managed.

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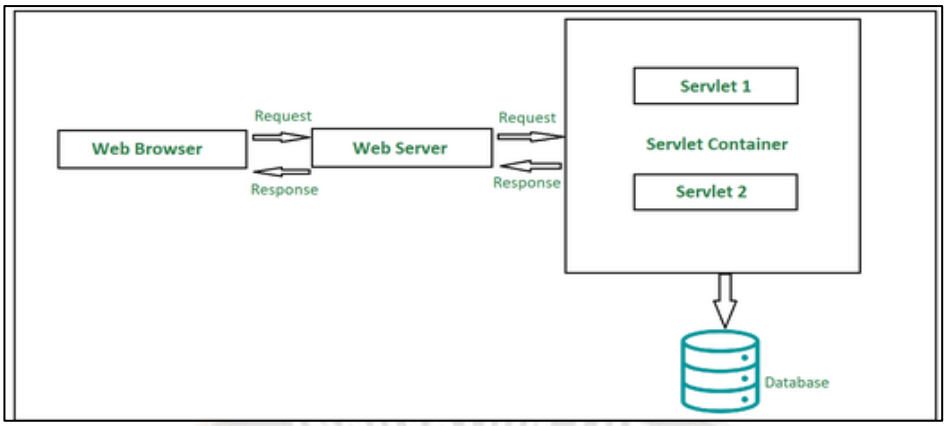

Figure 2: Servlet Architecture
(Source: https://www.geeksforgeeks.org)

Database Design and Schema

All the information will be stored in an organized way in the SQL database required for the project. Some of the tables in the database include "Books", "Users", "BorrowingHistory", and "Fines". The "Books" table will hold information about each book such as, title, author, date of publication and state of the book, whether it is available or borrowed out. The notion of "Users" will accommodate the users' data, including their names and addresses, and account information. The "BorrowingHistory" table will contain details of the borrowing and returning activities while the "Fines" table will contain the fines in case of delay in returning the books.

Implementation Process

The implementation process is initiated by creating the development atmosphere through the procurement of goodies like JDK, IntelliJ IDEA into the system, MySQL. Servlets will be written in JAVA and meant solely for handling the server side affair like processing the request and interacting with the database. Applets will be built to deploy a lively and friendly user interface at the client environment (Samiti's 2021). It is also worth saying that the SQL database will be specifically built to complement all the workings of the servlets, facilitating the data acquisition and changes. The system will be thoroughly checked to ensure that all the sub systems are integrated to work cohesively and offer the user a consistent experience.

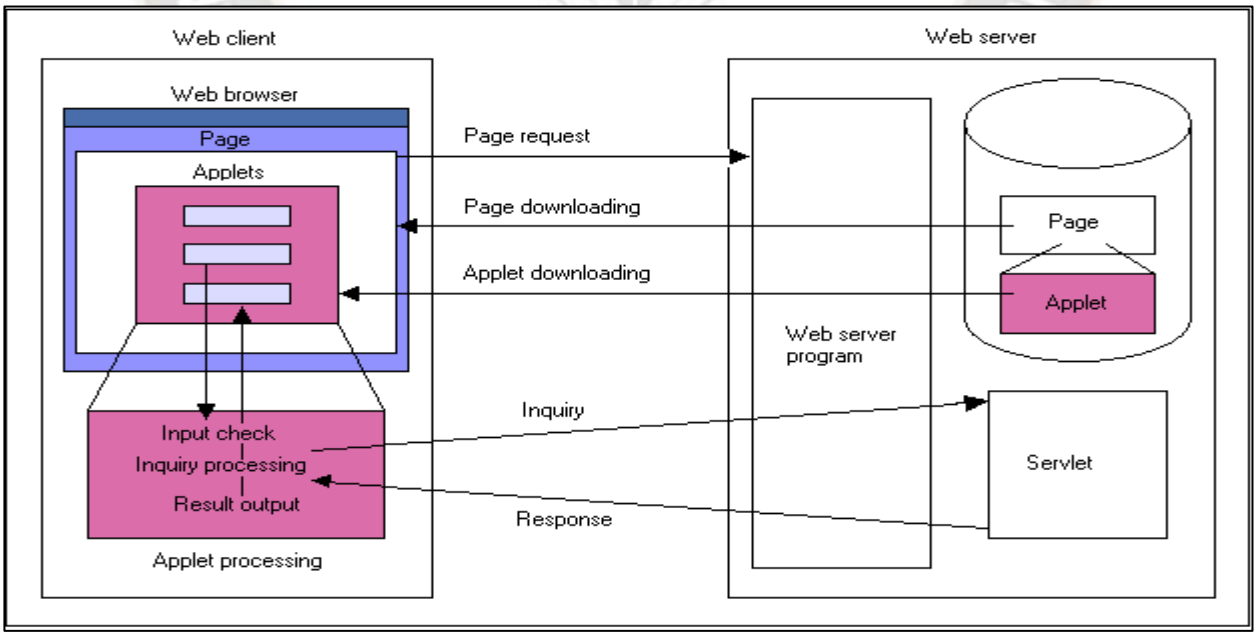

Figure 3: Applets in Web Browser Interaction Diagram
(Source: https://www.software.fujitsu.com)

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Testing and Evaluation

Testing consists in confirming the stability and performance of the system and its fulfillment of security requirements. Several test cases are then created for the Information System to check how the system will run in case that it always adds books, manages the account of the users, and takes into consideration the borrowing and returning of books (Li *et al.* 2021). Stress testing is used in order to determine the reaction of the system in regards to the amount of resources consumed. Security testing verifies that no users can access the parts of the system which they should not access, and that the system meets requirements in terms of data protection.

Result

System Functionality

The implemented library management system includes and efficiently utilizes servlets, applets, and an SQL database to manage the library. The system helps consumers in searching for books, in checking the availability of books and other account services and even by borrowing a history menu. The user interface is also designed and implemented using applets (Jin 2019). This makes it more interactive towards user experience. The server-side activities are likely to operate through servlets, thus enabling users' requests and access to databases with low delays.

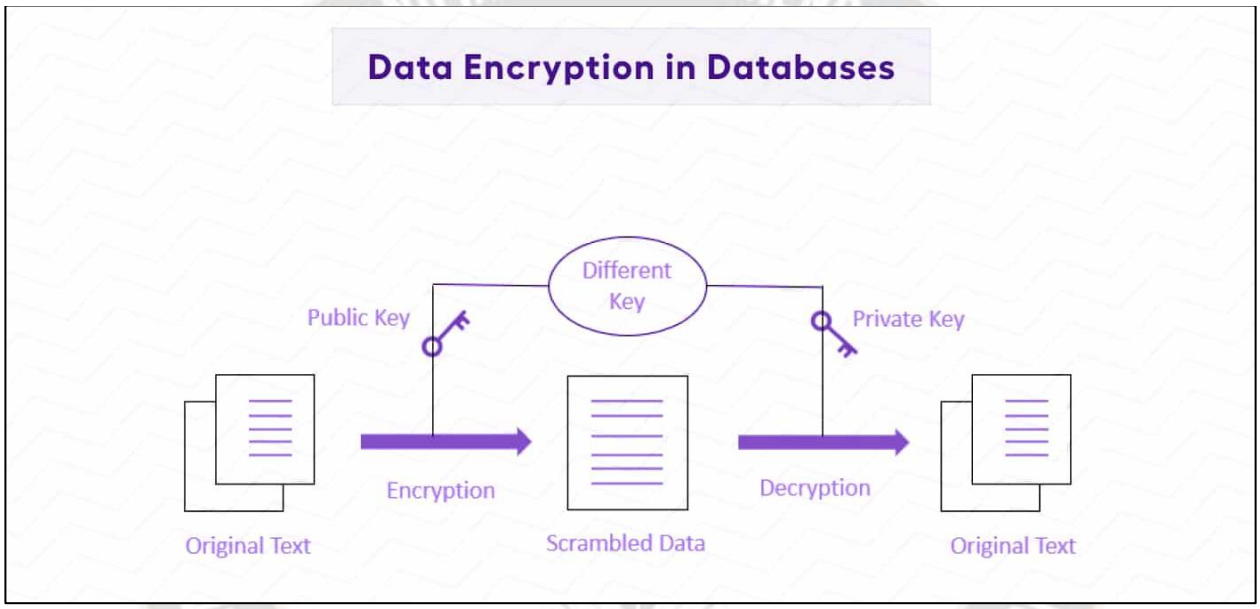

Figure 4: Data Encryption in Library Management System
(Source: https://www.redswitches.com)

Performance Evaluation

It demonstrates that the system is capable of running at various loads in terms of its various performances. This is despite the fact that the system receive high traffic in query requests from multiple users, the database response time is relatively low (Zhang and Wang 2021). Cost control also increases due to efficient use of resources hence the capacity of the system is also well checked. The database utilized in the application is SQL and while it is capable of holding a massive amount of data, there isn't much lag in the process.

Security and Data Integrity

Security testing proves that the system provides adequate safeguard measures for secured user data like account details and borrowing records. Data integrity is also important where all the transactions entered and stored in the database are free from loss and corruption (Grundy 2021). In general, the system is effective in achieving the goals which are to match the needs of most libraries by offering them a solution for precise and secure management of their activities.

Discussion

Through the utilization of servlets, applets in addition to an SQL database, the library management system satisfactorily handles issues of operation management challenges of the library. Thus, it can be noted that the use of the system can improve efficiency in automating activities like book cataloging, user's management, and borrowing procedures (Yousef *et al.* 2019). Usability test also shows that the system can support several clients at once with little delay, hence supporting scalability.

Nevertheless, the implementation was fraught with some issues especially concerning the interoperation of the applets with recently developed web browsers. It is imperative that

these compatibility problems are dealt with in ideas for the future. As much as there are compatibility challenges in the present buildings, there is a need to address the same in future works. Furthermore, data security and data integrity was something to be considered and the system proved to have offered adequate protection measures on user data. Overall, it can be stated that the system fulfils its intended goals and can serve as a basis for further developments.

Future Directions

When it comes to the improvements in the future, it is possible to follow the further development of the library management system, based on the following ideas, further enhancement of the system could be based on the substitution of the applets by the actual Web technologies (like JavaScript frameworks) that would allow supporting modern Web browsers more effectively (Mushtaq *et al.* 2019). The other area that needs enhancement is the possibility of adding more features such as the real-time notifications for due dates and overdue books and the recommendation system based on the borrower's history. Last but not the least, the system's scalability can also be increased for dealing with large no. of databases and large no. of users at a time in growing libraries.

Conclusion

The library management system, to a large extent, incorporates using servlets, applets, and an SQL database to address book cataloging, users' administration, and borrowing procedures. Overall, the system follows good workability as it can accommodate the participation of several users at once while it also administers available resources effectively. What could be done is that issues like compatibility of the software with the contemporary web browsers and the records' protection and safety were the issues achieved, but there is more to do.

Future improvements should be associated with the consistent usage of actual web technologies, as well as with the development of new features which will add up to the system's convenience and availability. The system forms a strong framework for controlling and preserving library resources with ability to incorporate new changes to suit current complex library environments thus guaranteeing optimal productivity and customer satisfaction.

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