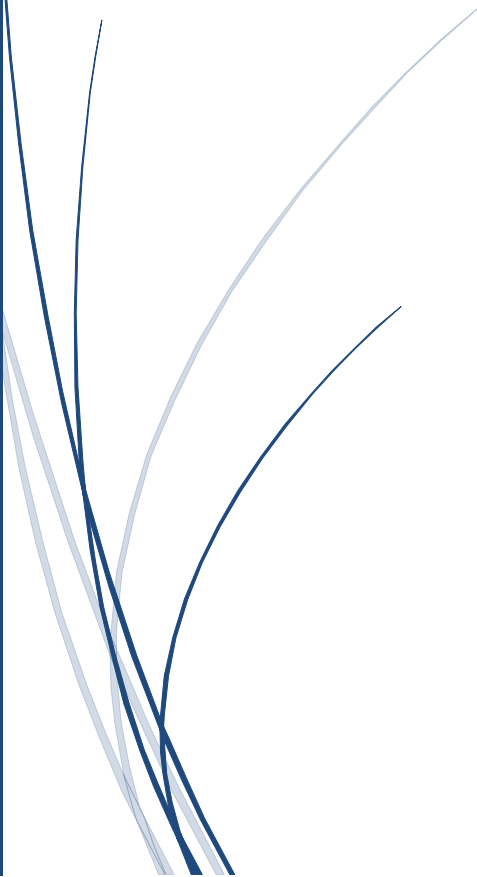




5/10/2021

Final Project Report

Library Management System



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1. Introduction:

The aim of this project is to build a decision support system for a university library. The library carries many books, journals, conference proceedings, reference books, and copies of some recorded lectures on CD. These items are loaned to members. Members of the library are mainly students, faculty, visiting scholars, and staff. This is an automated system that would facilitate the process of searching the database for books written by a particular author, books published by a certain publisher, books on a particular subject, etc. The project takes into consideration all the constraints provided as well as carry out some assumptions to support the data base and process flow.

2. Problem Statement:

The database of a library contains the various numbers of books, Journals, Conference proceedings, reference books, and copies of CD's containing recorded lectures. These various sources of information are loaned to various members including staff, faculty, students, and visiting scholars. There are various problems related to the loaning and returning of these items which are of great concern to the library manager. The manager often complains that few members are returning the borrowed items past their due date.

The manager wants to develop an automated system that will help him to find from the available database any specific publisher, book author, or any subject and further get its status. For this, it is necessary to maintain the database of each item in the library and make it distinct by assigning Unique ID to them. The automated system that I develop can check the decision on the status of the item i.e., shelf, borrowed, or overdue as well as provide reports for manual decision making.

While building the database and introducing a search function to help us find an item using the above-mentioned parameters it is necessary to develop an algorithm that will show the statistical results based on the library database. The statistical results will provide the librarian with information related to most borrowed books, favorite authors, most read items, and a brief report which will include the number of items that are available on the shelf of the library and the number of items which are loaned to members at any given time. To develop such a decision support system, it is crucial to include attributes and variables that include member id, name, address, and date of issue which will help the librarian to identify the due date, borrow date, and overdue. The above problems are critical in an effective and accurate decision support system and hence will be addressed by me in this Project.

3. Objective:

3.1 Developing a Decision Support System (DSS) with the database for the items present in the library with each being assigned a certain Unique Identification Number (UID).

- Books
- Journals
- CD
- Conference Proceedings
- Reference books
- Members

The database should incorporate minute information related to each item available in the library. Information like author name, publication name, publication year, edition of the journal, subject of the article, title, etc. should be included. The Decision support system should include a search tab for items and members by various attributes. Items should include attributes like the author, publisher, and title, whereas the members should include attributes like name, ID, address, and type of member (student or staff).

3.2 Developing a database that will help me to find the status of the item i.e., shelf, borrowed, or overdue while displaying the corresponding member details and a link for sending notice.

3.3 Developing an algorithm that will calculate the statistical parameters of the database and display statistical results in the form of a report. The report parameters include:

- Top 10 favorite author.
- Top 10 most read books.
- Most 5 read journals.
- Summary of the number of items that are loaned out and, in the inventory.

3.4 Constraints:

- Staff and faculties can borrow 5 items at a time and Students can borrow 3 items at a time.
- CDs are to be borrowed maximum for 3 hours and Journals can be borrowed for a maximum period of 2 days.
- Books can be borrowed for a maximum period of 2 months (60 days).
- Reference books have inhouse access only.

4. What is DSS?

Decision Support System are computerized and programmed systems of information which supports the decision-making activities (Power). DSS are the computer system which help the decision makers to process the information based on factors like communication, data, documents, knowledge, and models which help the decision makers to complete the expected task (Power). The data of the DSS can be represented graphically with the help of artificial intelligence or an expert system. The typical information which a DSS system can represent includes:

- a. Information from the rational and legitimate sources (Power)
- b. Comparative data figures (Power)
- c. Data acquired from assumptions or new sources (Power)
- d. Effects of the alternative data on decision system and reflected past results in the same context (Power).

There are 5 types of decision support system which can be categorized as follows:

- i. Communication driven DSS.
- ii. Data driven DSS.
- iii. Document driven DSS.
- iv. Knowledge driven DSS.
- v. Model Driven DSS.

Out of these 5 categories our decision support system is data driven DSS which consists of data related to various items in a library as mentioned in the problem statement.

5. Data Collection & Building:

The database will be functional only if it is populated with sufficient information and covers an array of variables that play an important role in the decision-making process. Sufficient data and necessary variables will lead to accurate results which is essential for tracking the items as well as send accurate notices. Basic data required for dataset building was acquired from an online source (kegggle.com) and significant efforts were put in to filter the data for meeting the variables requirements and additional variables were further introduced to satisfy all the required parameters in the process.

The excel sheet includes separate tabs for each of the required attributes i.e., Books, Reference Books, Journals, CDs, Conference Proceedings and Members.

- Books/ Reference books:

The data for title, author and publisher of the book are gathered from online source (kegggle.com) while the missing data with no source has been randomly generated. The data for publication year, edition, and subject have been randomly generated as well as the Unique Identification number for each of the books/reference.

- Journals/Conference proceedings:

The parameters for Journal and conference proceeding data such as UID, Volume, Number and Publication year are randomly generated in excel. The Titles on the other hand are acquired from online source (kegggle.com).

- CD's:

The parameters for CDs such as UID, Course Number and Date are randomly generated in excel. The Title and Professor Name on the other hand are acquired from online source (kegggle.com).

- Members:

The Member sheet contains detailed information of students, staff, faculty, and visiting scholars. Each member is assigned with UID and address which are acquired from an online source (kegggle.com)

Data from all the above tabs are accumulated to form the "Master Item Data", in other words, the sheet represents all the items that are present or borrowed by the Library. For a representation of this project, transactions from 6 June 2019 to 6 June 2020 have been utilized to form the "Historical Data" which serves as a fulfilment for the constraints put forward and the

assumptions been made. The system is running on the current date. The Member UID is linked with item UID randomly along with the type of item displayed in the next column. Borrow dates of the items by members (time in case of CD's) are randomly generated. Due dates take into consideration the constraints mentioned in our problem statements and differentiate with the type of item. Due date of a specific item is calculated by adding the two columns of borrow date/time and due date criteria according to the type of item. The number of days(hours for CDs) a member uses the item is randomly generated. The actual return date of the item is calculated by adding the columns of the borrow date and number of days/hours used.

Firstly, I acquired the status of the data for the year 2021 by applying the below conditions:

- If the return date is blank, then the book is borrowed.
- If due date = return date, then the book is on the shelf.
- If due date < return date, then the book is overdue.

Secondly, I compared the data with the current date to know the status of the item by applying the below conditions:

- If return date is blank, compare current date with due date.
- If current date < due date, then the item is borrowed.
- If current date > due date, then the item is overdue.
- If current date = due date, then the item is on shelf.
- If current date < return date, then the item is borrowed.
- If current date > return date, then the item is on shelf.
- If current date = return date, then the item is on shelf.

When a change is carried out in any of the parameters (e.g., current date) successive changes take place in the dependent cells and the same can be reflected in the status of the item i.e., shelf, borrowed or overdue.

6. Methods to develop statistics:

To generate results related to statistics such as top ten authors etc. and summary of item I have used a PostgreSQL, Java, Bootstrap, CSS3/HTML5, JavaScript & JSP to display the expected results.

Data from “Historical data” sheet is considered for generate the statistical report. Each report requested by user is stored in separate data sheet. Simple VBA code is used to show the required elements from pivot table stored in respective data sheets.

7. Data assumptions:

7.1 Quantity:

The quantity of the item i.e., the number of copies per book is assumed to be 1 each while building and searching database with a unique identification code.

7.2 System running on a specific date:

According to the problem statement of the project, the main feature of the search option is to show the status of the book i.e., loaned, shelf, or overdue. For satisfying these conditions I will need a specific date on which the system will be running to identify the item's due date based on its issue date and to identify if it is overdue or not. For this, I have considered the current date to be 24th April 2021. The flowchart shows the logic used for developing an algorithm for due dates and status of the items.

7.3 System Running on Specific Time at Specific Date:

The constraint related to CD is mentioned in the problem statement that the CDs can be loaned only in the library and the maximum time to loan the CD is 3 hours that is why there is a need to introduce the new parameter of time constraint in our database. To help the search feature in our program to identify the status of the CD there is a need to specify the current time while running the database which I have assumed to around 10 pm.

The following assumptions are made based on time constraints:

- Borrowed time of an item for the current date i.e., 24th of April 2021 is from 8 am till 6pm.
- CD's can be loaned only till 6 pm.

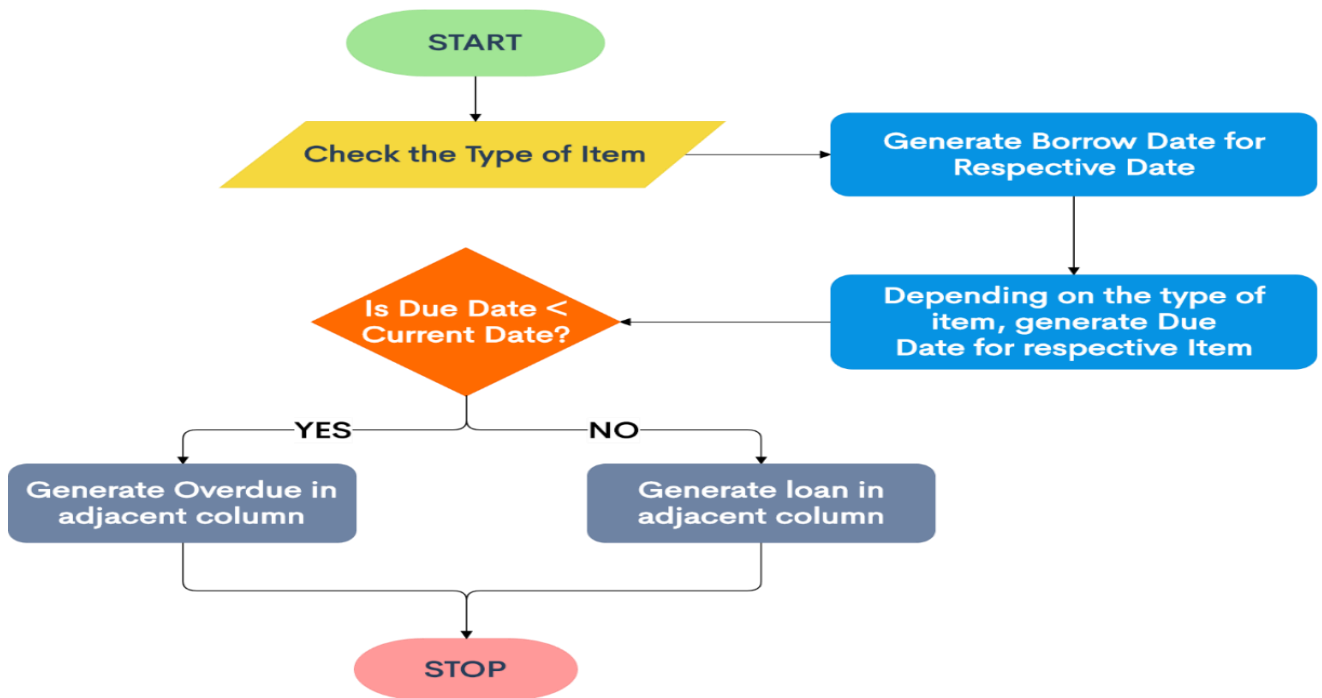


Figure 7.1. Algorithm to develop a logic for the status of items.

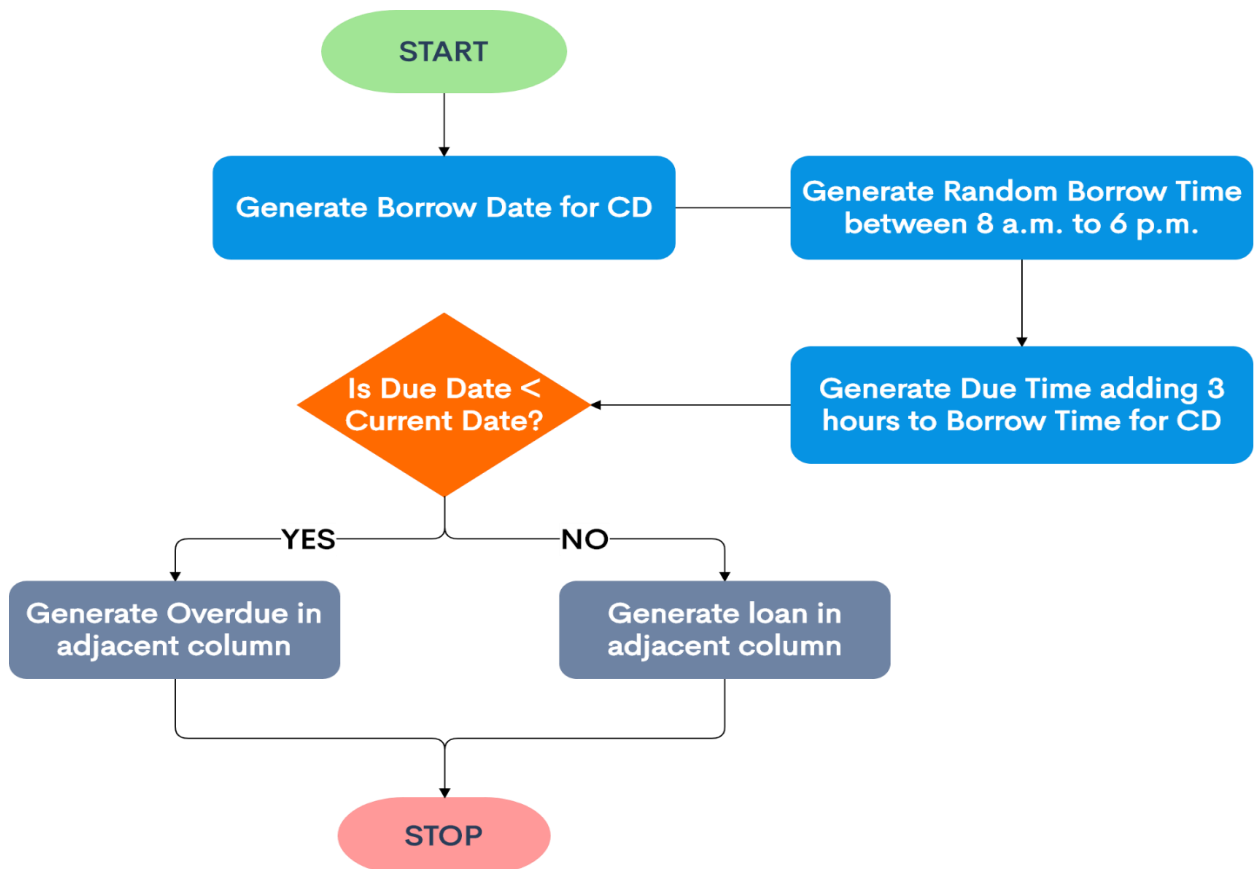


Figure 7.2. Algorithm to develop a logic for status of CDs loaned.

8. Risk Involved:

- The major risk is of the algorithm in datasheet which is responsible for accurate results. If the algorithm fails or is inaccurate then it may create disruptions in the results.
- The section in which I search for any book or unique identification number depends on the excel data. If any column or row gets misplaced, then it may result in some error which can cause an inaccurate result. Once the data is feed into the application. Application will provide the results accordingly.
- Earlier, since it was all Excel sheet data, it was very difficult to secure the data. However, with the web application data is secured but since it is developed using open source there are chances that someone will try to break the application.

9. System design:

The basic workflow of our system user interface is divided into three categories namely:

- a. Statistics
- b. Status of item
- c. Book search

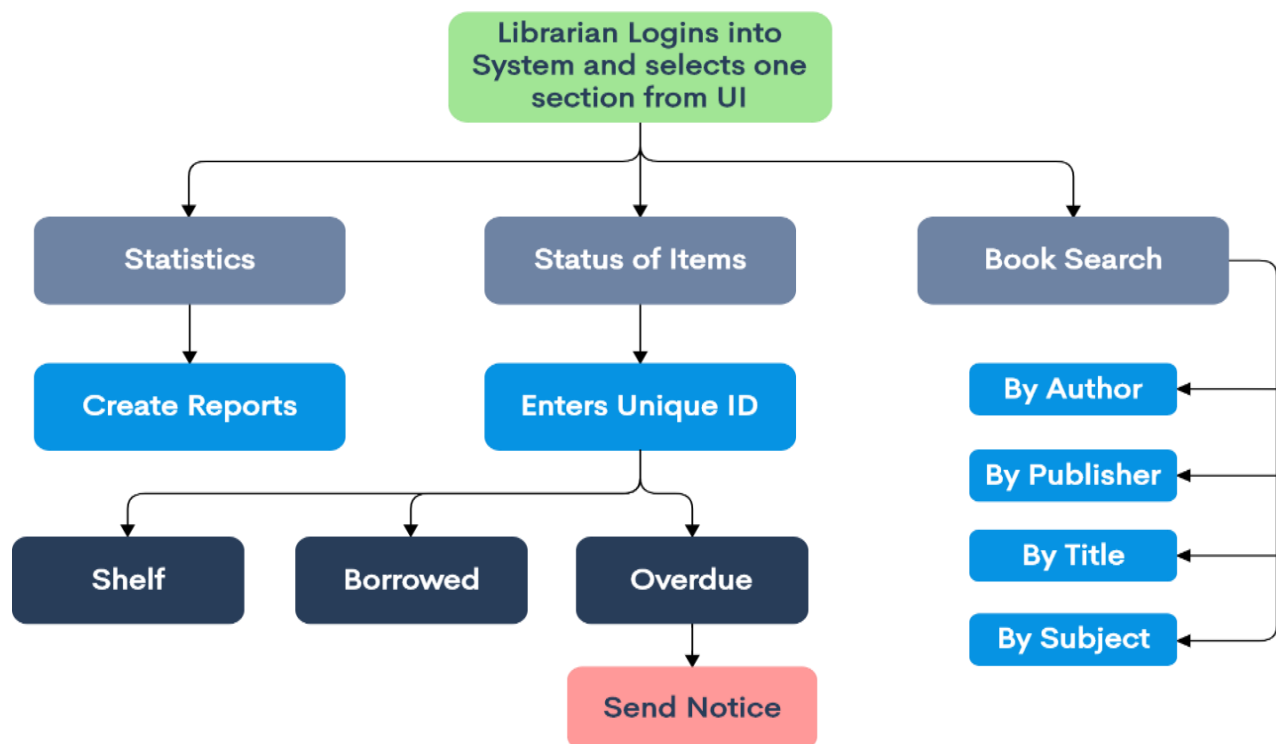


Figure 9. Basic Workflow

I will discuss the function and feature of each tab in detail below:

9.1 Home Tab:

Landing page displaying the current functionalities and the problem statement. It has live timer to check the current date and time with login/logout feature and restriction based on the users. Only Admin has the privilege to use the complete feature of the application. Normal users/employees can check the other features (except upload) of the application.

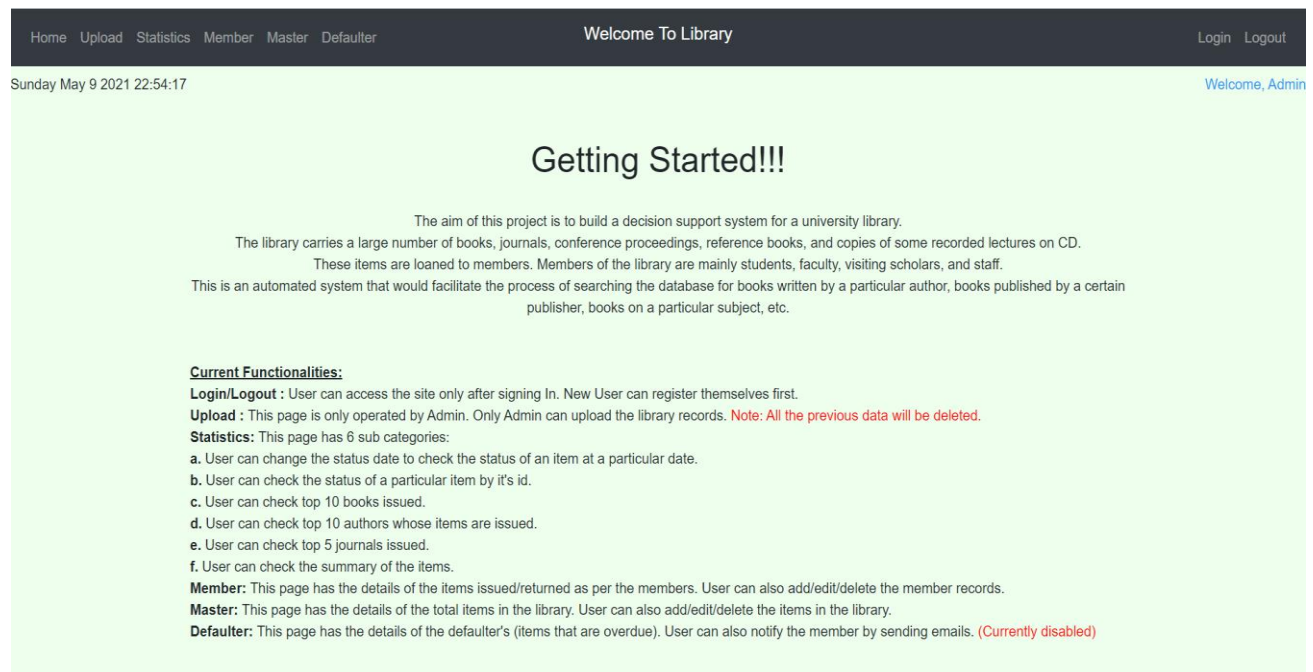


Figure 9.1. Home Page.

9.2 Login/Logout/Register Tab:

User can access the site only after signing In. New User can register themselves first. There is also a feature of forget password which asks the user to enter name, email address and security answer user has given while registering on the application. After providing all the fields details the password will be available to the user on the home page itself. On Login a session is created for each user and on logout that user session is destroyed.

Sunday May 9 2021 23:02:09

LOGIN PAGE

New Registration

[< Back](#)

Figure 9.2.1. Registration Page

Home Upload Statistics Member Master Defaulter

Welcome To Library

Login Logout

Sunday May 9 2021 23:06:14

LOGIN PAGE

Request Password

[< Back](#)

Figure 9.2.2. Request Password Page

Home Upload Statistics Member Master Defaulter

Welcome To Library

Login Logout

Sunday May 9 2021 23:17:48

LOGIN PAGE

Sign In

[Forgot password?](#)

Figure 9.2.3. Login Page

9.3 Upload Tab:

Upload page is used to upload the excel sheet having daily data to create daily updated report (Statistics Tab) and populate the inventory (Master Tab), daily transactions (Member Tab), notify defaulters (Defaulter Tab), etc. It resets the inventory every time the data is uploaded.

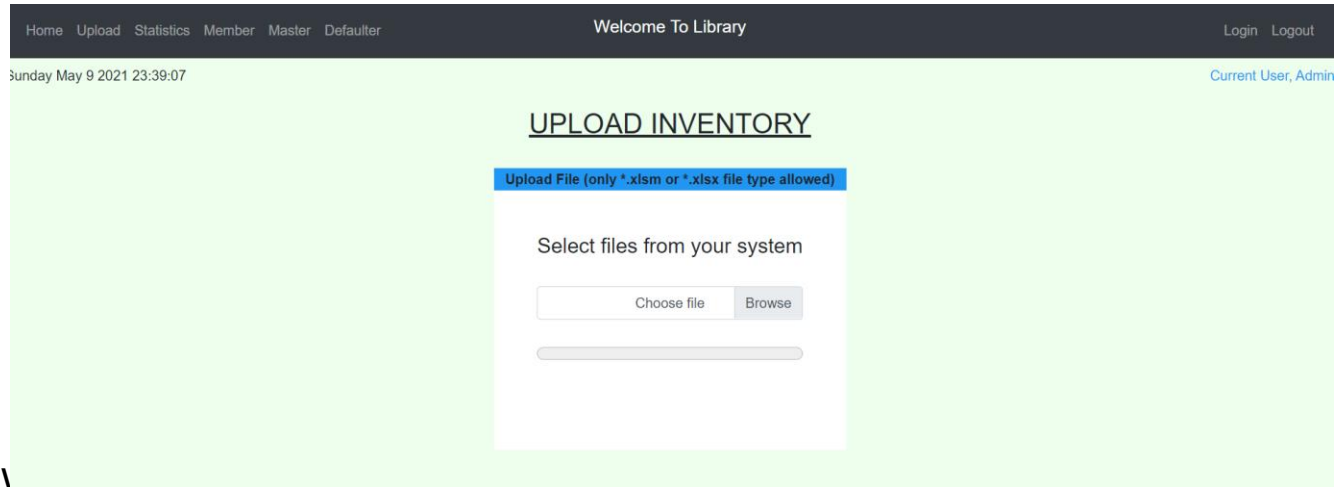


Figure 9.3. Upload Page

9.4 Statistics Tab:

Statistics tab will help us to display the reports generated related to the total number of items i.e., books, reference books, conference proceedings, CDs, Journals available in the library, and the total number of items lent. It generates a report with specific criteria as follows:

- Report containing the top ten most popular books of the year.
- Report containing the top ten most popular authors of the year.
- Report containing five most-read journals.

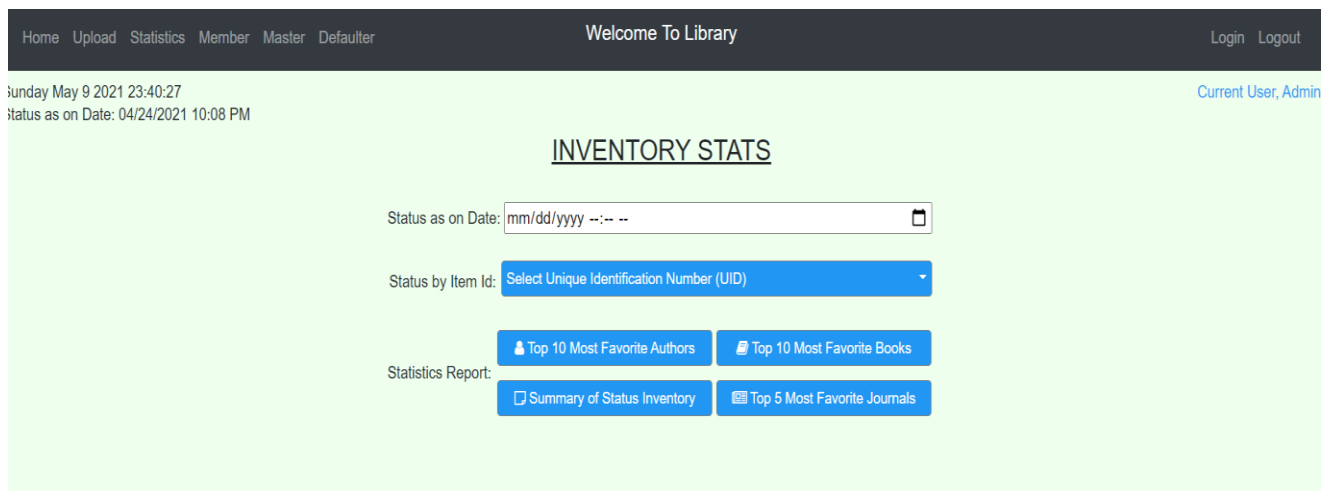


Figure 9.4.1. Statistics Page.

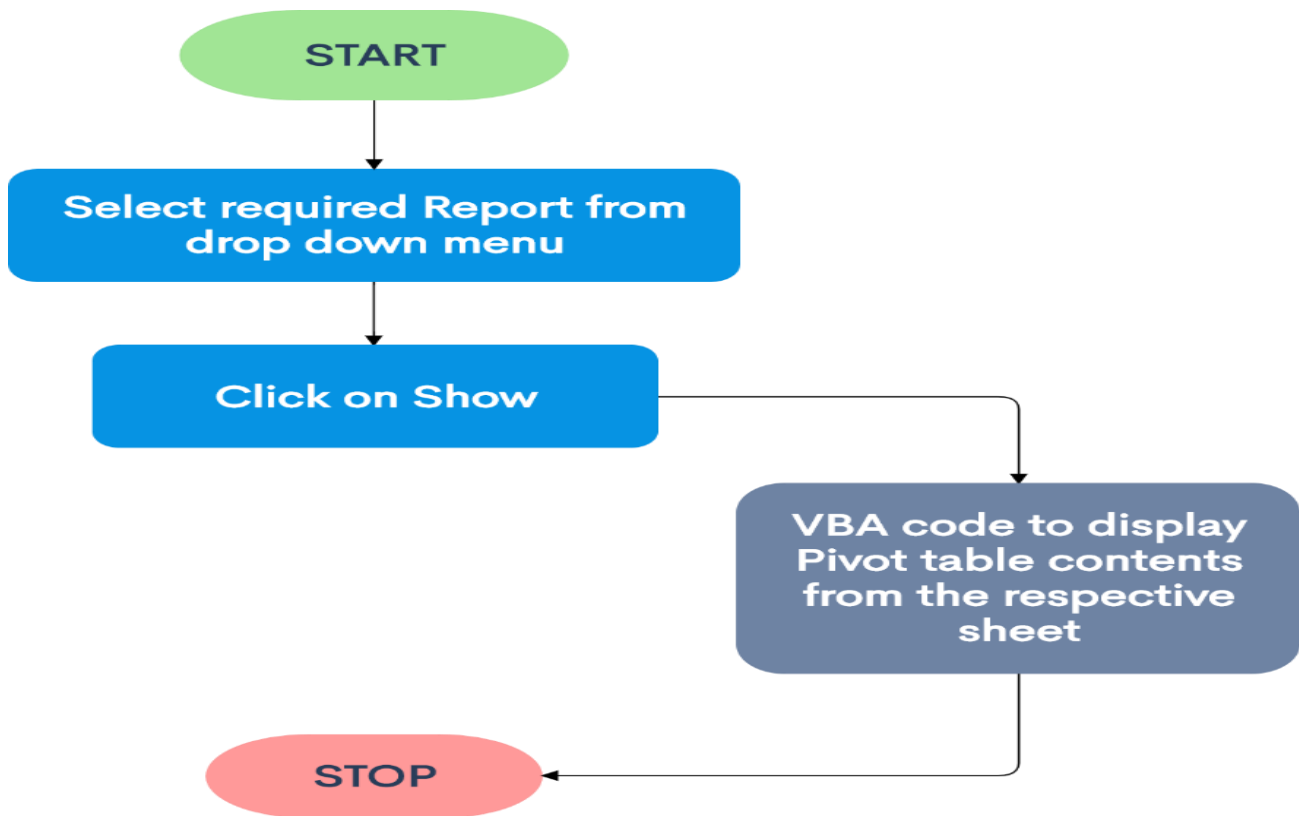


Figure 9.4.2. Algorithm to develop Report in Statistics.

9.4.1 Ability to check status on any date:

User/Admin can check the status of the item by any date by just selecting the date and it will provide the result as per the date chosen. After entering the UID, we get a detail related to that specific item, the members ID and detailed information related to that item. An example of the report generated when we search through UID can be seen in Figure 9.4.2.1.

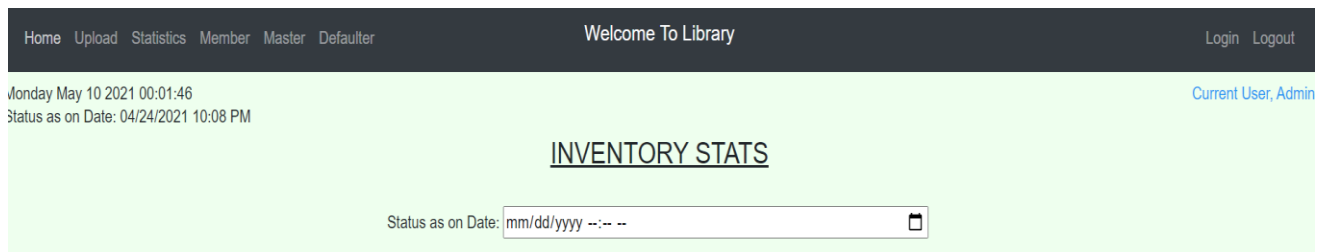


Figure 9.4.1.1. Statistics Page.

9.4.2 Status by Item Id:

By entering the unique identification code of the item, the system will search in the “Historic Data” sheet to display the status of the item as calculated by the formulas. If the status of the item is overdue, a pop-up window will be followed which will guide the librarymanager to send notice to the member who has borrowed that specific item.

The status of the item is classified into three categories:

- Shelf
- Borrowed
- Overdue

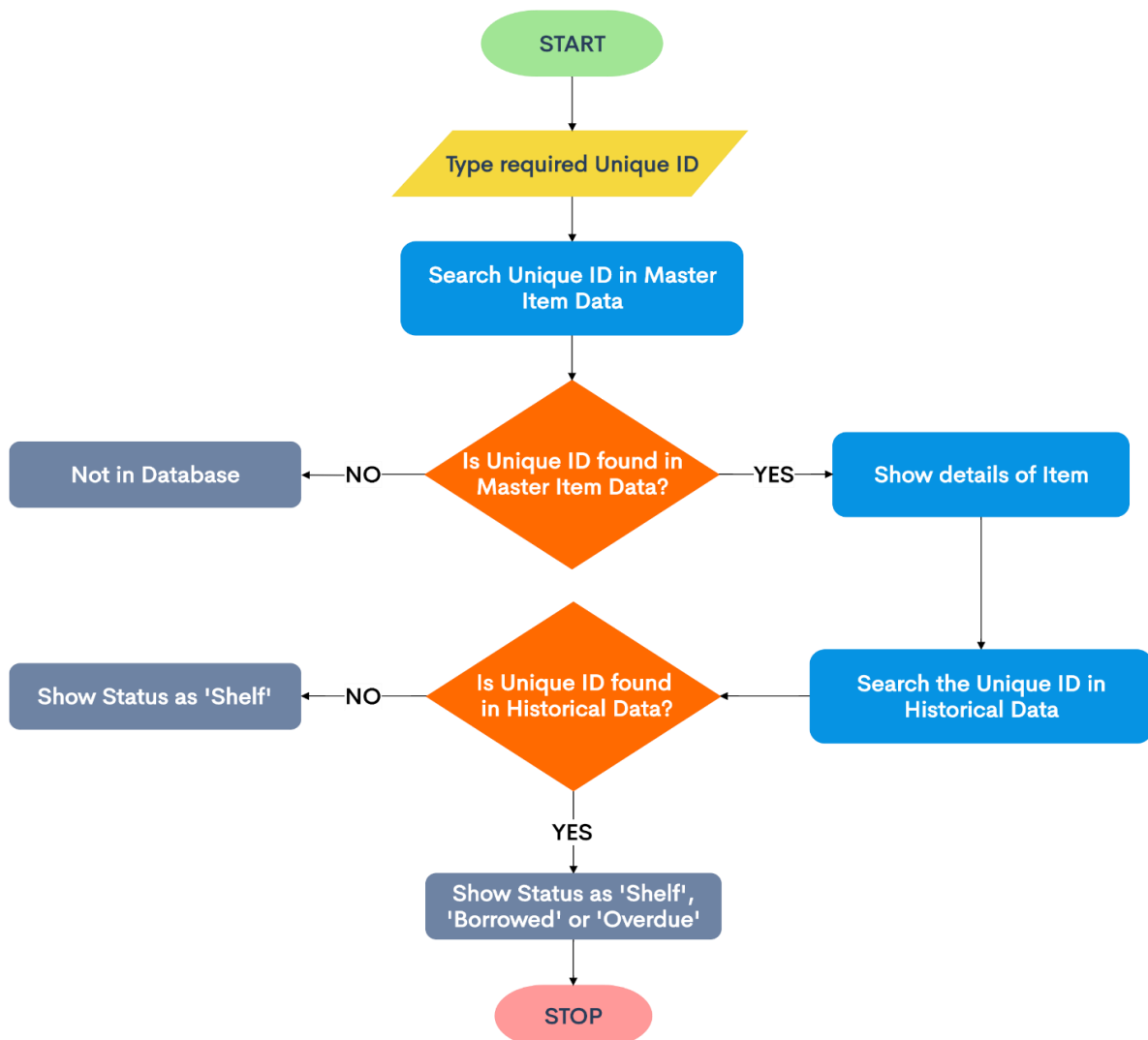


Figure 9.4.2.1. Algorithm to get the Status of an Item.

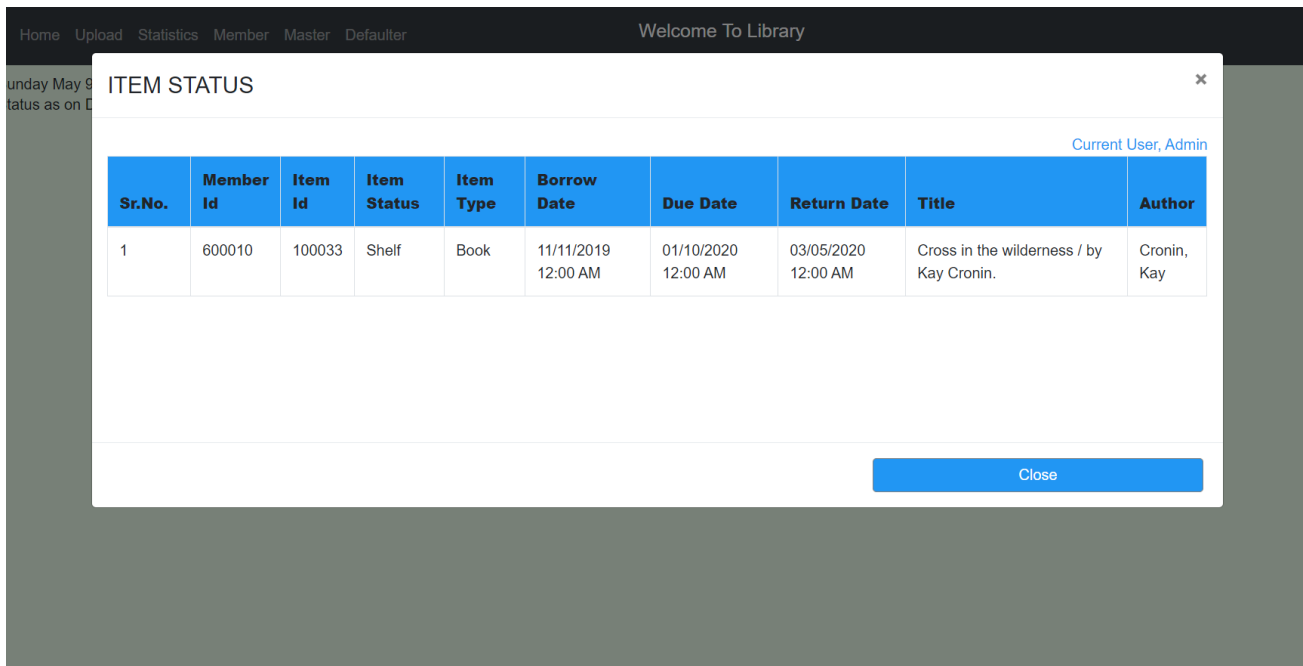


Figure 9.4.2.2. Status by Item Modal.

9.4.3 Statistics Report:

The third section of our system user interface allows the library manager to search a book based on one of the following criteria:

- Search by Author
- Search by Publisher
- Search by Title
- Search by Subject

After clicking the desired section from the dropdown menu, we get results accordingly.

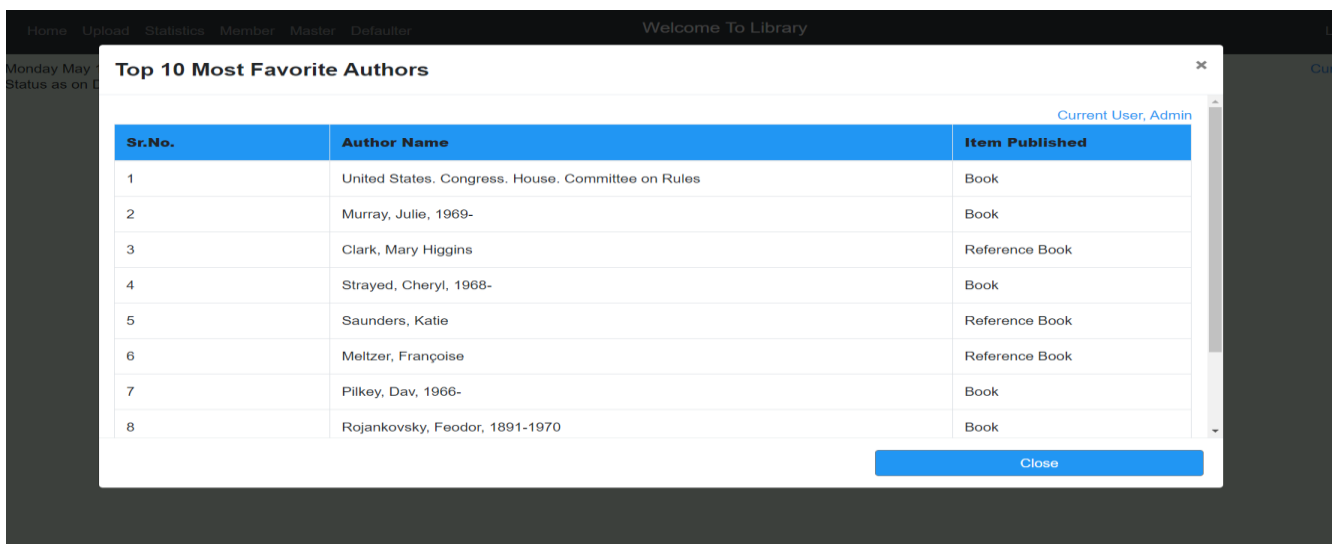


Figure 9.4.3.1. Top 10 Most Favorite Authors.

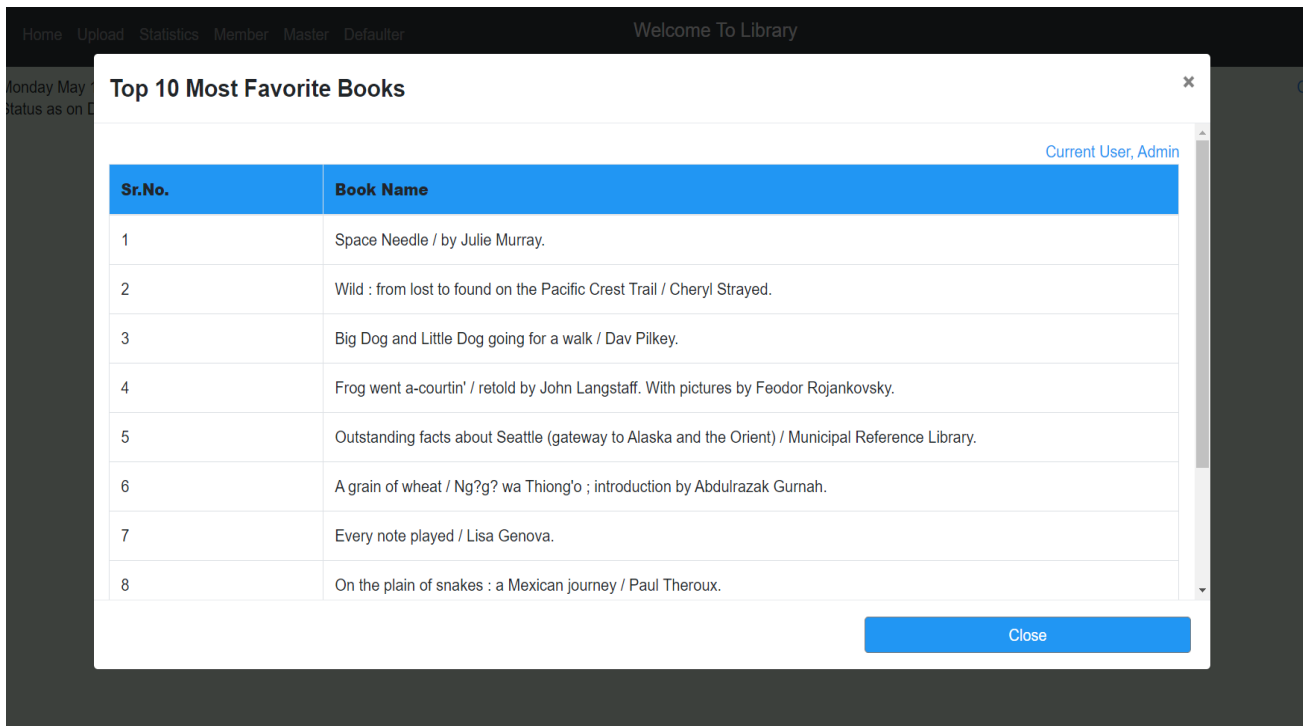


Figure 9.4.3.2. Top 10 Most Favorite Books.

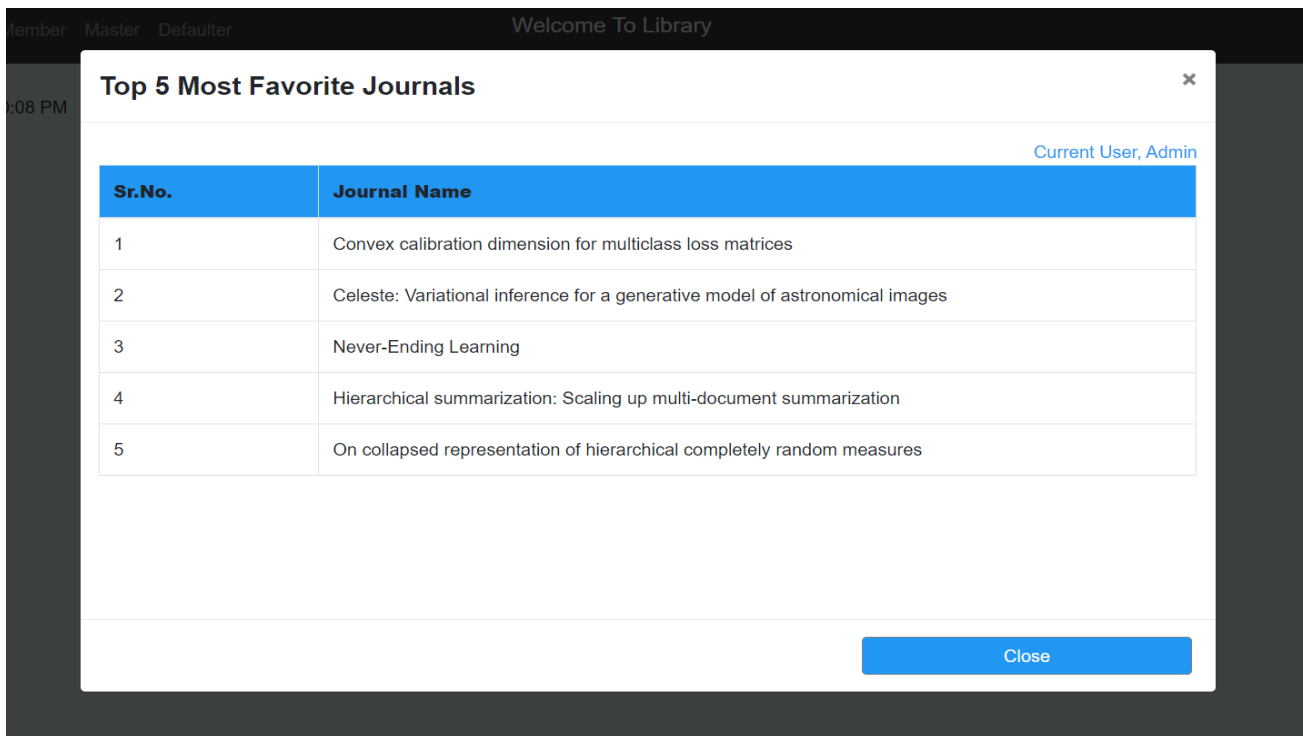


Figure 9.4.3.3. Top 10 Most Favorite Journals.

ember Master Defaulter Welcome To Library

08 PM

Summary of Current Library Inventory

Current User, Admin

Sr.No.	Item Type	Borrowed	OverDue	Total Number of Items
1	Journal	0	14	100
2	Conference Proceedings	0	13	100
3	CD	0	10	251
4	Reference Book	0	15	840
5	Book	1	19	1000
6	Grand Total	1	71	2291

Total Number of Items Currently in the Inventory: 2219

Close

Figure 9.4.3.4. Summary of Current Library Inventory.

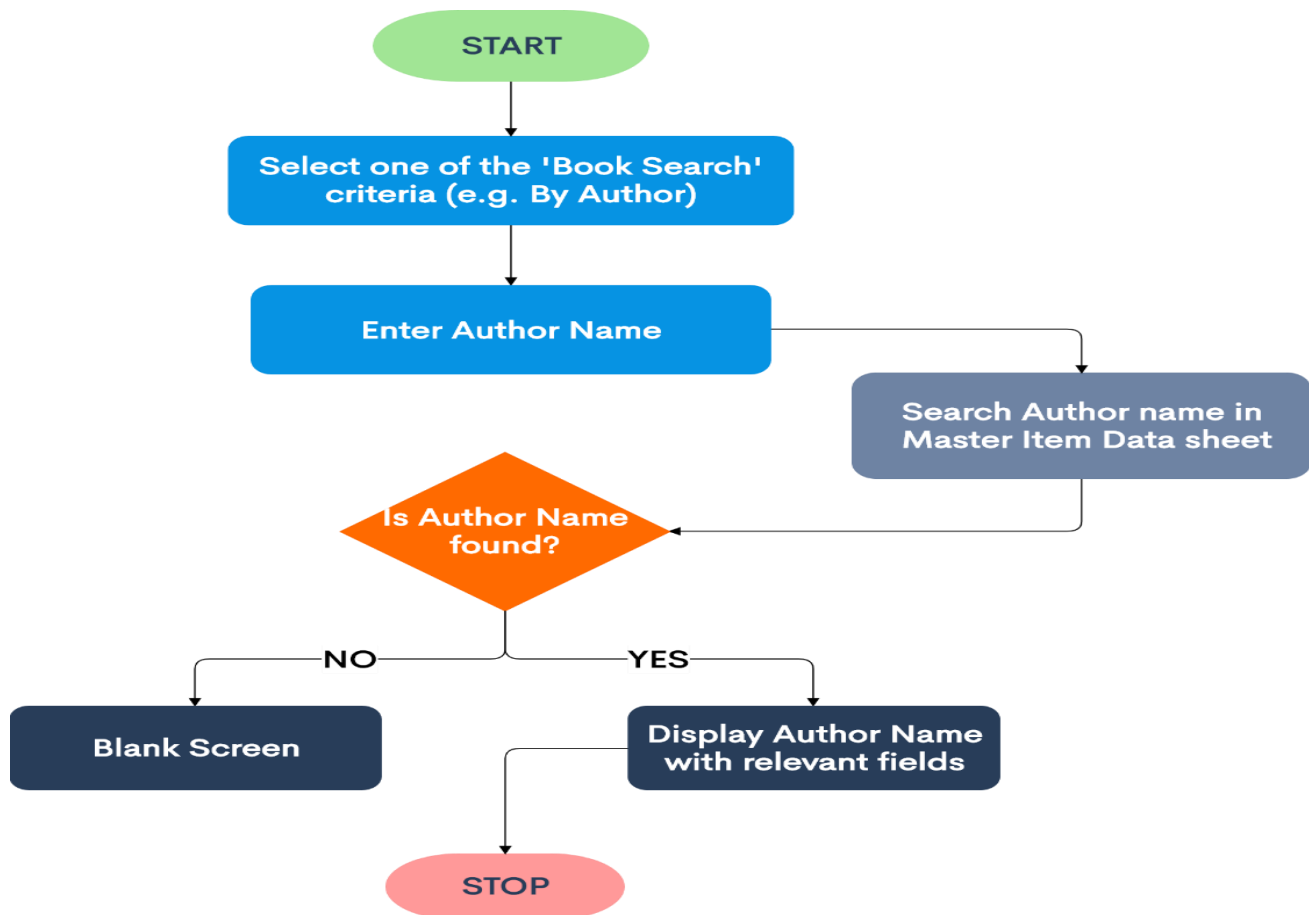


Figure 9.4.3.5. Algorithm to search a Book.

9.5 Member Tab:

Member Tab contains all the transactions and details of the members. One can add, edit, and delete the record. Also, with the help of data table one can retrieve the data in all sorts of combinations i.e., copy the data, get it in csv, excel or pdf. Can also print the records.

Home

Upload

Statistics

Member

Master

Defaulter

Welcome To Library

Login

Logout

Monday May 10 2021 00:27:22

Current User, Admin

Status as on Date: 04/24/2021 10:08 PM

MEMBER INVENTORY

Add New Record

show

3

entries

Search:

Copy

CSV

Excel

PDF

Print all (not just selected)

Previous

1

2

3

4

5

...

103

Next

Member Id	Item Id	Item Status	Item Type	Borrow Date	Due Date	Return Date	Title	Author	Actions
60001	100003	Borrowed	Book	04/20/2021 11:01 AM	06/20/2021 11:01 AM	NOT RETURNED	John Marin. / Edited by Cleve Gray.	Jerrold, Blanchard, 1826-1884	<div>Edit</div> <div>Delete</div>
600001	500062	Over Due	Conference Proceedings	03/09/2020 12:00 AM	03/11/2020 12:00 AM	NOT RETURNED	Parameter screening and optimisation for ILP using designed experiments		<div>Edit</div> <div>Delete</div>
600002	100437	Shelf	Book	07/20/2019 12:00 AM	09/18/2019 12:00 AM	12/07/2019 12:00 AM	The dragon prophecy : the fourth adventure in the Kingdom of Fantasy / text by Geronimo Stilton ; illustrations by Danilo Barozzi, Silvia Bigolin, and Giuseppe Giundani ; translated by Julia Heim.	Stilton, Geronimo	<div>Edit</div> <div>Delete</div>

Showing 1 to 3 of 307 entries

Figure 9.5. Member Inventory.

9.6 Master Tab:

Master Tab – it is basically the inventory of all the available items in the library. Like Member Tab, it has all the functionalities. Users can also add, edit, and delete the inventory items.

Home
Upload
Statistics
Member
Master
Defaulter

Welcome To Library

Login
Logout

Monday May 10 2021 00:33:30

Current User, Admin

Add New Record

Show3entries

Copy

CSV

Excel

PDF

Print all (not just selected)

Previous

1

2

3

4

5

...

764

Next

Search:

Item Id	Item Type	Title	Author	Publisher	Publication Year	Edition	Subject	Actions
100001	Book	The first hundred years of Niño Cochise; the untold story of an Apache Indian chief / as told by Ciyé "Niño" Cochise to A. Kinney Griffith.	Cochise, Ciyé, 1874-	Abelard-Schuman,	1971	7	Humanities	<a>Edit <a>Delete
100002	Book	History of German art; painting, sculpture, architecture. / Translated by Tessa Sayle.	Lindemann, Gottfried	Praeger,	1971	1	Computer Science	<a>Edit <a>Delete
100003	Book	John Marin. / Edited by Cleve Gray.	Jerrold, Blanchard, 1826-1884	Holt, Rinehart and Winston,	1970	3	Humanities	<a>Edit <a>Delete

Showing 1 to 3 of 2,291 entries

Figure 9.6. Master Inventory.

9.7 Defaulter Tab:

Defaulter Tab – This is an additional functionality that a conventional excel data driven project cannot fulfil. This gives the list of all the defaulters and the ability to notify them via email. Due to sensitive data restriction, I have currently disabled this feature. But one can add his/her personal email credentials to notify the users by downloading and uploading the application on his/her own hosting server and use it. Example of it is shown below.

HomeUploadStatisticsMemberMasterDefaulter

Welcome To Library

LoginLogout

Monday May 10 2021 00:35:10

Status as on Date: 04/24/2021 10:08 PM

Current User, Admin

DEFaulter LIST

Show4entries

Search:

CopyCSVExcelPDFPrint all (not just selected)

Previous12345...18Next

Member Id	Item Id	Item Type	Due Date	Title	Author	Action
600001	500062	Conference Proceedings	03/11/2020 12:00 AM	Parameter screening and optimisation for ILP using designed experiments		<div>Notify</div>
600002	200776	Reference Book	08/08/2020 12:00 AM	The real Wallis Simpson : a new history of the American divorcee who became the Duchess of Windsor / Anna Pasternak.	Pasternak, Anna, 1967-	<div>Notify</div>
600011	500045	Conference Proceedings	05/10/2020 12:00 AM	Prediction of learning curves in machine translation		<div>Notify</div>
600014	500057	Conference Proceedings	06/23/2020 12:00 AM	Comparison of wavelet based watermarking techniques Using SVD		<div>Notify</div>

Figure 9.7.1 Defaulter List.

Home Upload Statistics Member Master Defaulter						Welcome To Library		Login	Logout				
Monday May 10 2021 00:41:40 Status as on Date: 04/24/2021 10:08 PM								Current User, Admin					
NOTIFY MEMBER													
Recipient address		600001@gmail.com											
Subject		Overdue Notice for Item Id: 500062											
Content		<p>Contact Your Library Directly. Do Not Reply to this Email.</p> <p>The following Library material is overdue.</p> <p>1. Item Id: 500062</p> <p>2. Item Type: Conference Proceedings</p> <p>3. Item Title: Parameter screening and optimisation for ILP using designed experiments</p> <p>4. Item Author:</p> <p>5. Item was Due on: 03/11/2020 12:00 AM</p> <p>Please return them as soon as possible. Please contact the library if you have already returned them.</p> <p>Thank you.</p>											
Send Email													

Figure 9.7.2 Email Notifier.

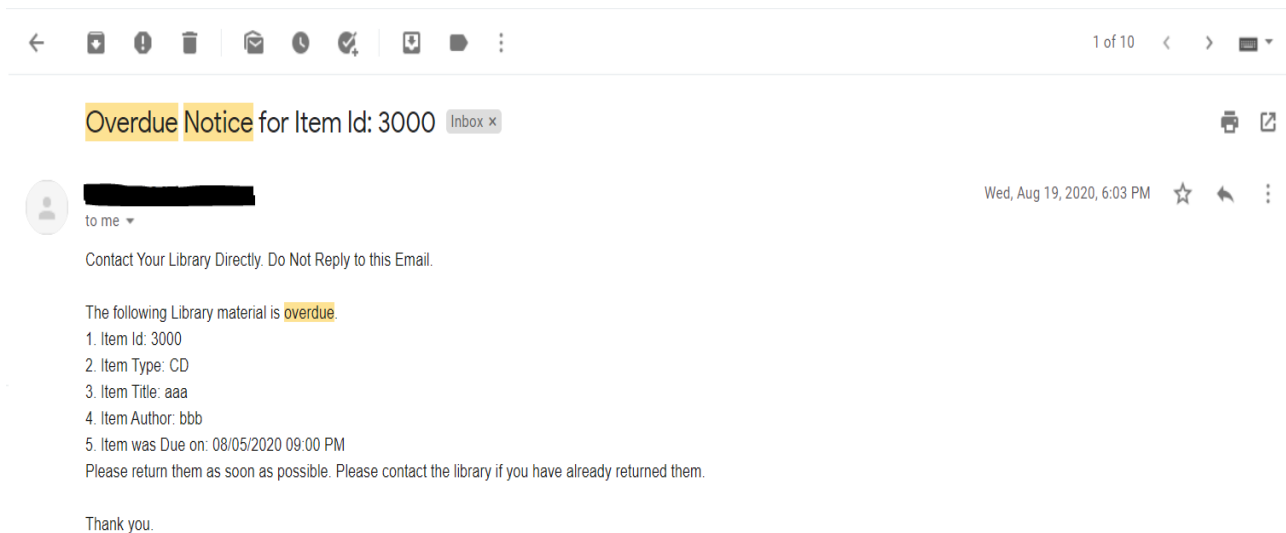


Figure 9.7.3 Email Received by end user (members in our case).

10. Challenges Faced:

- The main challenge faced was building the upload functionality loading all the excel data into the database properly and accurately.
- Also, creating the excel records was one of the major challenges. As the book quantity are assumed to be one, it was difficult to assign any book to any member without checking its past status because borrow status of a book should not overlap with the past issuer of the same book.
- Comparison of various dates like borrow date, due date and return date to show the output of status of the item when compared to current date was another major challenge faced.
- This web application gives that feature by uploading the excel data and driving the application from there. I had to develop the application based on the original Visual Basic (Macros) giving it a web look and designing the complex PostgreSQL queries.

11. Technologies Used:

Backend	Java
Frontend	JSP-Servlet, Bootstrap, CSS3, HTML5, JavaScript
Database	PostgreSQL
Cloud	Heroku Platform
Tools	Eclipse Ide, Maven, Heroku Pipeline, GitHub

12. Application Details:

Web Application URL	https://library-management-system-grad.herokuapp.com/
GitHub Repo URL	https://github.com/AkshayDhruv/Library-Management-System
Test Credentials	Contact the Developer for Admin Credentials
Sample Datasheet	https://github.com/AkshayDhruv/Library-Management-System/tree/main/resources

13. Conclusion:

The main intension of this study is to build a Decision Support System for the hulking Database in a university library. The dataset supporting the developed user interface is cleaned and compiled using an online resource in association with the random commands in excel and then uploaded onto the web application.

The developed system will be a handy tool for the Library manager to know the status of the items which are borrowed, shelf, or overdue. For this, I successfully developed a user interface earlier VBA now a web application which could help the Library manager in tracking the status using the current date and time.

The developed system will equip the library staff to maintain the daily records with minimum human errors as the system will be executed using a unique identification number thoroughly.

14. References:

1. <https://devcenter.heroku.com/>
2. <https://docs.oracle.com/en/java/>
3. <https://maven.apache.org/guides/>
4. <https://www.postgresql.org/docs/>
5. <https://getbootstrap.com/docs/5.0/getting-started/introduction/>