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**An Automated Library Resource
Management System**

Group #3

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EXECUTIVE SUMMARY

The existing library resource management systems in most of the universities function in a very conventional manner. The conventional system involves the use of a computer that is connected to the university database, which bears the records of the students/library member. There is the use of registers, which have details filled in, which is then updated onto the computers and so on. Hence, there is a chance of missing out on data entries or mismanagement due to human errors. So, a new automatic intelligent system is required which can ease the process and reduce the errors, while increasing the effectiveness due to the elimination of human interference.

The objectives of the project would be to design “An Automated Library Resource Management System” to provide self-check-in, self-checkout facility, and other services like resource renewal by means of kiosks that allow the college members to check in and check out the library resources conveniently. The library should have search stations that can be used to log in and search for study resources from the library catalogue and check for their availability. One member should be able to access one kiosk at a time. The member enters details at the kiosk and gets access to his/her individual member account. The member’s account should be linked to the college library database that keeps track of the resources, in and out of the library. The system should bear least human interference and should be secured enough. Also, the member should be able to drop the issued resource at the kiosk. In addition to this, the system must provide appropriate security provisions to prevent loss/theft of resources from the library. The system will be used effectively to manage library resources without any loss due to human errors and thereby manage them in the most effective way. The target users of the system include students, faculty and university staff who are given authorized access to use the university resources.

1. INTRODUCTION

Background:

The Library resource management system plays a very crucial role in managing the university library resources. But the existing systems in most of the universities function in a very conventional manner. For example, if a book (a university resource) has to be checked-in or checked-out from the library, the conventional system involves the use of a computer that is connected to the university database that holds member records. The library personnel offer a register wherein the user has to enter his/her details so as to gain access to the library resources. The personnel then accesses the computer database by a personal computer and then registers the actions in the system. This existing system is not foolproof as the personnel might miss out data entry of some of the resources due to human errors. There are chances that the book or other resources might be mismanaged if this system is used. It is also cumbersome for the library staff to locate the books or resources in the classified sections of the library. So a new system that is intelligent and automatic, is the need of time.

Motivation and Objective:

The conventional system doesn't guide the member to the respective resource he/she wants to seek. An automated library resource management system eases the process of searching a resource, giving the local location of the resource and showing the member the shortest path to locate the resource. A new system shall help the user member to check-in or check-out the resources of the library. This is done without the interference of human beings, thereby reducing the errors and increasing the effectiveness. Also, in this system, the member can go to the library and can search for the book or other resources in the online portal that is linked to his/her student membership account present in the university database. It is advantageous and time-saving when it is compared with the existing system. The system should be linked to this database directly and should assist the member users accordingly. The member user can perform other operations like check-out the resource and then while returning the same, the member user either uses the drop-off facility of the library or returns the resource to the library or renews it online through the library portal (as per his/her requirement) using this system.

Hence, some of our main objectives through this project are:

1. To provide library members with a kiosk service which is user-friendly and easy to manage.
2. Help the library staff by reducing their workload, hence saving time, effort and the possibility of making errors.
3. Help the users to make an automatic request for new resources to the library if the resource is consistently not available when it is searched for more than 5 times.

Approach: Our approach to this problem is to develop an automated library resource management system that includes smart technology to guide the user to the needed resource by means of computer controlled kiosks which will help reduce the time taken in comparison to the conventional system. For the project, we have used Java in eclipse environment with the help of a plug-in called Jigloo to make GUI and an add-on called Apache POI library to export and import data from the database in Microsoft Excel.

2. THE ENGINEERING PROBLEM

The current system used in libraries is very traditional and requires a lot of manual labor as well as takes a lot of time. The problem we are dealing with is that the system we are using is not very advanced and a time and labor can be saved while introducing a new advanced system using modern technology. As mentioned in the background, the current practice to rent a book is to search for the book, take it to the librarian and get it checked out. The problem with the current practice is a lot of manual labor is used and also, a lot of time is wasted in trying to find the book etc. We want to infuse technology into the library resource management system and make it easier for people to handle resources. Hence, we propose a new resource management system that possesses methods wherein, the library will send the member a notification on the registered mobile number, which will contain the exact floor number (section number), stack number, and rack number for where the resources are located, thereby reducing the time required to obtain the resources. It should also be able to offer the members of the library, the right kind of services (like check-in, check-out facilities, locating books in the book stacks, finding the availability of the books. offering security provisions to make the system robust etc.) Also, the member plans can be renewed at the kiosks in our newly proposed system. The goal of this project is to provide an automatic, simple, secure and efficient resource management system.

Problem Statement:

Design an “Automated library resource management system” to provide self-check-in, self-check-out facility, and other services like resource renewal by means of kiosks that allow the college members to check in and check out the library resources conveniently”. The library should have search stations that can be used to log in and search for study resources from the library catalogue and check for their availability. Assume that one member should be able to access one kiosk at a time. The member enters details at the kiosk and gets access to his/her individual member account. The member’s account should be linked to the college library database that keeps track of the resources, in and out of the library. The members should be able to check whether a particular resource is available in the library or not and get it issued accordingly. In order to obtain the resources, the system should be able to guide the user member by giving proper directions as to where to go and find the resource when the member searches a particular resource and wants to get it issued. The system should bear least human interference and should be secured enough. Also, the member should be able to drop the issued resource at the kiosk. In most of the college libraries, it is observed that the resources that are lost/found as a result of weak management system are larger in number. Hence, the problem scope is to develop a system that overcomes this problem of resource mismanagement. In addition to this, the system must provide appropriate security provisions to prevent loss/theft of resources from the library. The system will be used effectively to manage library resources without any loss due to human errors and thereby manage them in the most effective way.

3. SYSTEM FUNCTIONAL SPECIFICATION

The functions that our Library Resource Management System achieves are:

Access Database: The user can access all of the resources present in the database, which include books, CDs, and DVDs as well as journals.

- Search for a particular resource: The user can enter either the name of the resource or author or title of the book/CD/DVD/journal or type in a keyword to search for the resource that he/she wants.
- Check-in Resources: The user can return the resource that he has issued at the Kiosk. He is supposed to scan the barcode with the help of the barcode reader and then deposit the resource in the drop box next to the Kiosk.
- Check-out Resources: The user can issue a resource at the Kiosk. Also, he can search.
- Request Resource Renewal: The user can request for the renewal of the resource.
- Pay Fine: When the user has resources beyond the due date, he is requested to pay a fine depending on the number of days that he has kept the resource beyond the due date.
- Request Direction for Resources: The user can request the kiosk for directions to the resource required.
- Check for Resource Availability: When a request is made, the system checks whether the resource is in the library or it is checked out.
- Maintain records of Resources: When a resource is checked in, the records must be automatically updated by the system while scanning the barcode.
- Calculate and Issue Fine: The system should calculate the fine based on how much past the due date the return is. It should also display fines (penalty) on the screen, avoiding the user to check out any other items. It should also accept fines (penalty) by credit/debit cards or guide the student to a nearby registrar in the library.
- Issue Resource/Check-out Resource: When a student wants to check out an item, the system should check for any holds on the account and if there are none, it should issue the resource and print out a receipt. Also, it should mark the resource as checked out in its database.
- Accept returned resources/Check-in Resource: After it has accepted the fine amount, or if the student is not late in returning the resource, the system should accept the resource and mark it ‘available’ in its database. Also, it should clear out the ‘pending’ in the students account.
- Renew Resources: When the resource is scanned, the system should check whether a request for it has been made by some other library member or not. If someone has already made a request, the student cannot renew the resource and the must return it. If no one else has requested it, the student can renew the resource for a certain amount of days and the due date is changed in the records and a new receipt is printed.
- Text User directions about the resource requested: When the student requests directions, the system sends a text message to the student about the location of the resource located in the library. The system gets this information from the database.

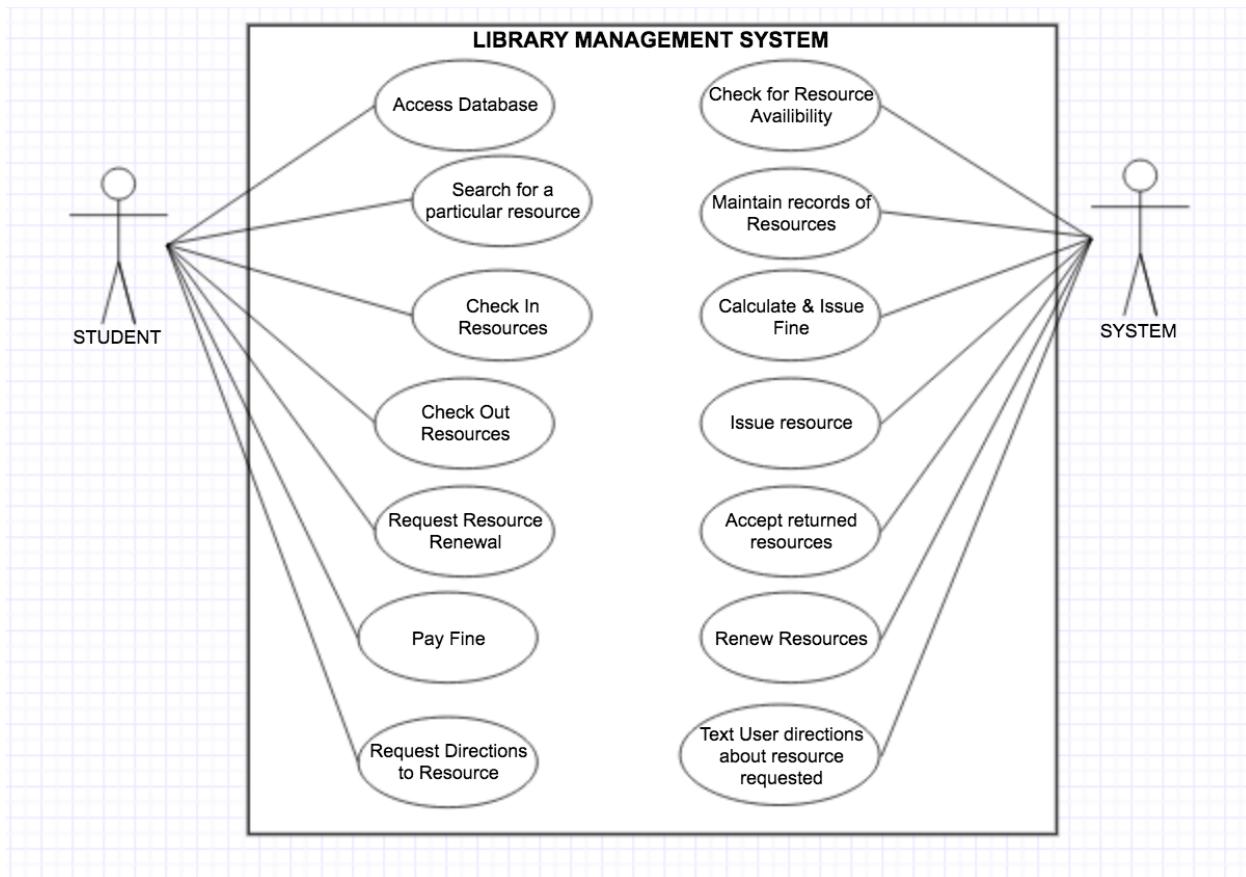


Figure 1. Use Case Diagram

As an explanation of the Use Case Diagram, let us take a scenario where a student is late in returning a resource and wants to check out another resource (DVD). The student walks into the library to return a resource. He is guided to a computer kiosk, which is equipped with a bar code reader. When he scans the resource, he is alerted that the resource is past due and the fine is calculated and displayed. The student was already informed that the resource is due via a text message on the date it was due. The student cannot proceed without paying the fine. Hence, the student has the option of swiping his credit card or paying by cash. After the fine has been paid, the student can return the resource. The resource is then marked available for other users to access. The student then searches for a DVD in the database on the kiosk. When he finds the DVD he needs, he can see on the screen whether it is available in the library or has been checked out by someone else. If it is available, he has an option to obtain the location details via text notification on his registered contact. These location details will assist him to the location of resource in the library. For example “Leavey Library, 2nd Floor Compartment Number 4 Stack Number 6.” The student can then get the DVD and go to one of the kiosks again. He can there scan the DVD and the screen will let him know when the item is due. To rent it, the student just has to swipe his student ID card, and the system then updates the resource as checked out in its database. It then prints out a receipt and the student is good to leave from the nearest exit.

4. OBJECT MODELING

To create an object model, all the nouns from the problem statement were selected.

The list is as follows:

| | | | |
|-----------------|--------------------|-----------------|---------------------|
| self-check-in | self-check-out | renewal | kiosks |
| log in | library catalogue | member account | library database |
| college members | library resources | search stations | lost/found |
| directions | human interference | drop | security provisions |

Among these only the right objects majorly associated with the context were classified and were taken into consideration. All the other redundant objects were discarded.

Refined objects

| | | | |
|-----------------------|------------------|------------|----------------------|
| Kiosks | College Members | CDs & DVDs | Request new resource |
| Data Centre | Library Resource | Services | Renewal |
| Location | Book | Check IN | Detector Exit |
| Reminder Notification | Journals | Check Out | Security |

4.1 Object Model

The selected problem is to build an intelligent automatic library resource management system that meets the following system requirements:

Data Dictionary:

Isolated words have too many interpretations. Hence, a data dictionary has been prepared for all the modeling entities. The scope of each class within the current problem has been mentioned along with associations, attributes, and operations.

| | |
|-------------|--|
| Kiosks | Kiosks is defined as the interactive resource search stations, is the topmost class containing the attributes Library Name, Library ID. The display menu operation denotes the operation to be carried out in this class wherein a menu is displayed to the user on the interactive screen. |
| Data Centre | This class contains the information pertaining to the location of the resources in the library. Details, as to where the resource is located are precisely specified by the Location class. This class also maintains records of all the members of the library and the resources being issued in their name. This class is like the hard disk of the library which holds all the relevant data. Here a member can register to the library or cancel his membership. |

| | |
|-----------------------|--|
| Location | This class stores the location of each and every item in the library. It has attributes such as floor number (section number), stack number and rack number. These define the ideal coordinates to guide the college member to locate the resource without any trouble. |
| Reminder Notification | The database will notify the member as to when the resource is due and that a fine will be imposed, if the resource is not returned by the given date. |
| College Members | All students and professors who are registered to the library belong to this class. Their details are stored in the database and they can search in the database for the resource that they want. They can get the item issued for a specific number of days and return it back to the library. |
| Library Resource | This is a general class which classifies all the items present in the library. A resource can be issued by the library member for a specific period of time. This class has 3 main subclasses; namely CDs and DVDs, Books, and Journals. The subclass of library resource class extends the functionalities of the library resource class. This class has details of the item. E.g. book - ID, title, author, and ISBN. |
| Services | <p>The system offers many services namely check-in, check-out, renewal, and make a new resource request.</p> <ul style="list-style-type: none"> (i) check-in – the user can drop an already issued resource at the kiosk (ii) check-out – the user can borrow a resource from the library (iii) renewal- the user can renew a borrowed resource at the kiosk itself (iv) make a new resource request - the user can request a new resource |
| Detector Exit | This checks for the receipt that the member receives after checking in or checking out a resource. If the user fails to verify the receipt at the exit, the alarm rings and the user will be questioned by the security. |
| Security | If the alarm rings then the security will question the user and retrieve the object and guide him to the exit. |

Associations of the library resource management system model:

1. Library resource management system includes kiosks.
2. Library provides the database.
3. Library database maintains user accounts.
4. Library owns kiosks.
5. Kiosks help search library resources.
6. Kiosk interacts with the user.
7. Kiosks communicate with the database.
8. Kiosk processes the transaction if a fine is imposed.
9. Dropbox accepts library resources checked in.
10. The university holds students accounts.
11. Database systems provide record keeping.
12. The system sends SMS to users about the library resource location.
13. Kiosks are provided with bar code readers.
14. Barcode readers are used to scan barcodes present on the resources.
15. Library employs security personnel.

Description of the functionalities of each class:

The modeling steps that guide the user are as follows:

1. The Kiosks, defined as the interactive resource search stations, are mentioned is the topmost class bearing the attributes Library Name, Library ID. The display_menu operation denotes the operation to be carried out in this class wherein a menu is displayed to the user on the interactive screen.
2. The Kiosks assist the college members. So, the class that is associated with the Kiosks class is the College Members class. Attributes of this class include Member_Name, Member_ID and Phone Number. Also, the operations involved included display_verification details (say, two-step verification method), display_account_details, display_resource_status and receive_location.
3. The Kiosks class is also connected to the university library data center defined by the Data Center class. It provides the necessary details on request.
4. The Data Center class connected to the Reminder Notification class. The Reminder Notification class has attributes like Due_Date (of the resource), Member_name, Member_ID, Member_phone and Member_email. It also includes operations like send_text_notification and send_email_notification. When the resource return date is due, the data center will automatically notify the users by sending alerts.
5. The Data Center also contains the location information of the resources in the library. The location details as to where the resource is located are precisely specified by the Location class. The Location class contains attributes like floor number (section number), stack

number and rack number. These define the ideal coordinates to guide the college member.

6. The college member can search the resources from the Library Resources class. This Library Resources class is again linked to the Data Center class, thereby making Data Center class as a centralized system that governs the entire functioning of the system.
7. The Library Resources class includes attributes like Type of Resources and one can accordingly select_resource_type.
8. The subclasses Books, Journals, and CDs & DVDs are the library resources that are inherited from the superclass Library Resources.
9. The resource type is a discriminator that defines the how these subclasses relate the superclass Library Resources.
10. The subclass Books contains attributes like Book Title, Book ID, Availability, ISBN and operations like display_status, display_location_details and send_location_details.
11. Similarly, the subclass Journals contains attributes like Journal Title, Area of Interest, Availability and Author and operations like display_status, display_location_details and send_location_details.
12. The subclass CDs and DVDs contains attributes like CD/DVD Title, Area of Interest, Age Restriction and Tutor details and operations like display_status, display_location_details and send_location_details.
13. As these subclasses are connected to the College Member class, the College Member can receive location details as the Library Resources class is linked to the Data Center class bearing another class i.e Location, storing the details as to where the resources can be found.
14. The College Members can access the services offered by this system. These services are defined by Services class. The Services class offers different service types
15. The Check IN, Check OUT, and Renewals subclasses are the services offered by the Services superclass.
16. The Check IN subclass class contains resource_ID as the attribute and the operations like resource_barcode_detect, resource_accept_status, calculate_fine, fine_amount, enter_resource_dropbox and print_receipt.
17. The Check OUT subclass class contains resource_ID as the attribute and the operations like resource_barcode_detect, resource_issued_status and print_receipt.
18. The Renewals subclass class contains resource_ID as the attribute and the operations like resource_barcode_detect, display_validupto, display_renew_status, and print_receipt.
19. All these three subclasses direct the college member to the Detector Exit. The Detector Exit class bears an attribute resource_ID and the operations like resource_barcode_detect and trigger alarm.

20. The Detector Exit class is also linked to the data center as it can check the details in coordination with the services offered.
21. The Request New Resource subclass class to the Services class contains resource_Name as the attribute and the operation enterResourceName()
22. If the alarm triggers, it means that the college member has not made an entry in the system using the services offered and in that case another class Security offers security provision to the system. The Security class contains attributes like security_guard_number (of the guard that will be present at the exit) and exit_number. Also, it includes operation like guide_member.
23. The security guard guides the college member (found along with the resource - whose entry is not done) to the Kiosks.
24. If the alarm does not trigger, it means that the college member has successfully made the data entry in the Data center using the Services and is free to Exit. The Exit class bears an attribute Exit Number.

An Automated Library Resource Management System

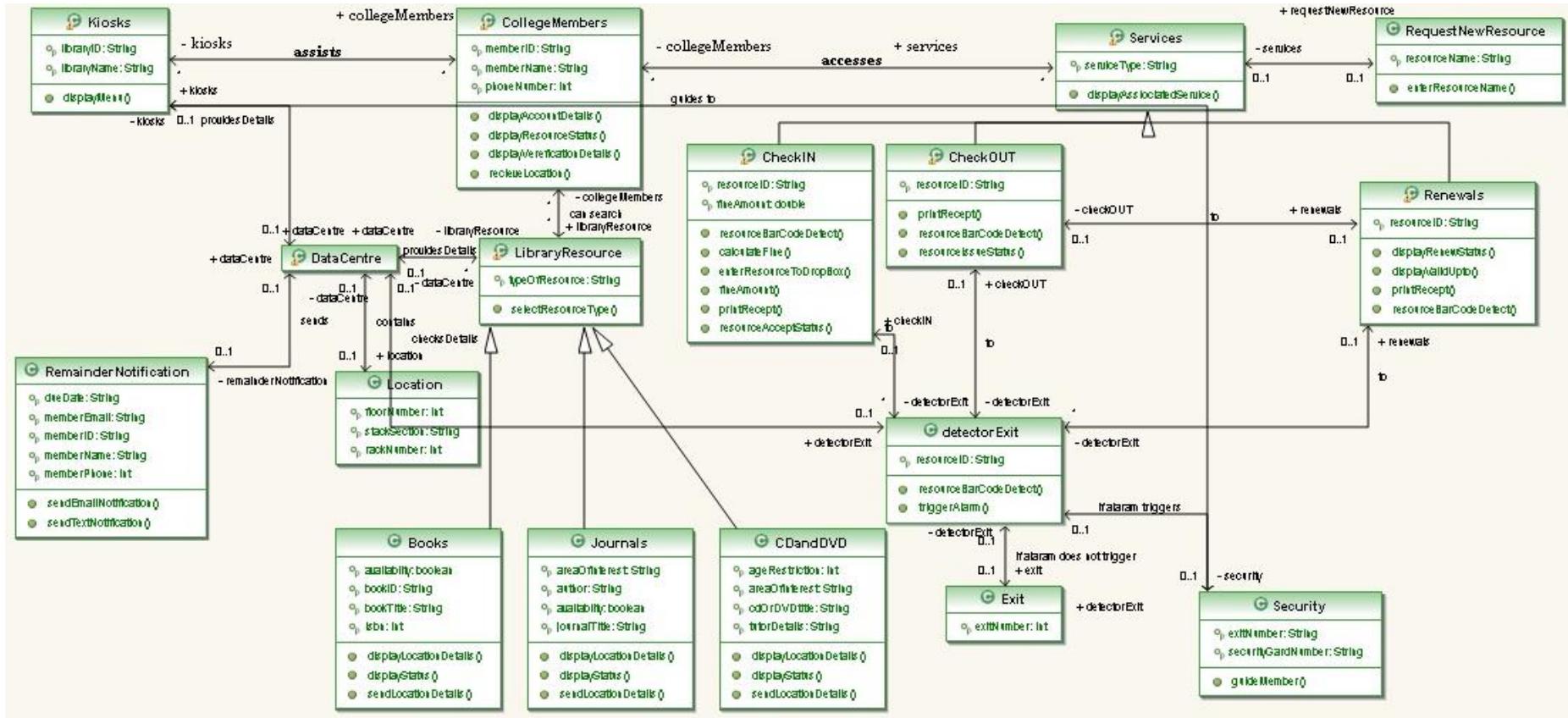


Figure 2: UML Class diagram in Java.

An Automated Library Resource Management System

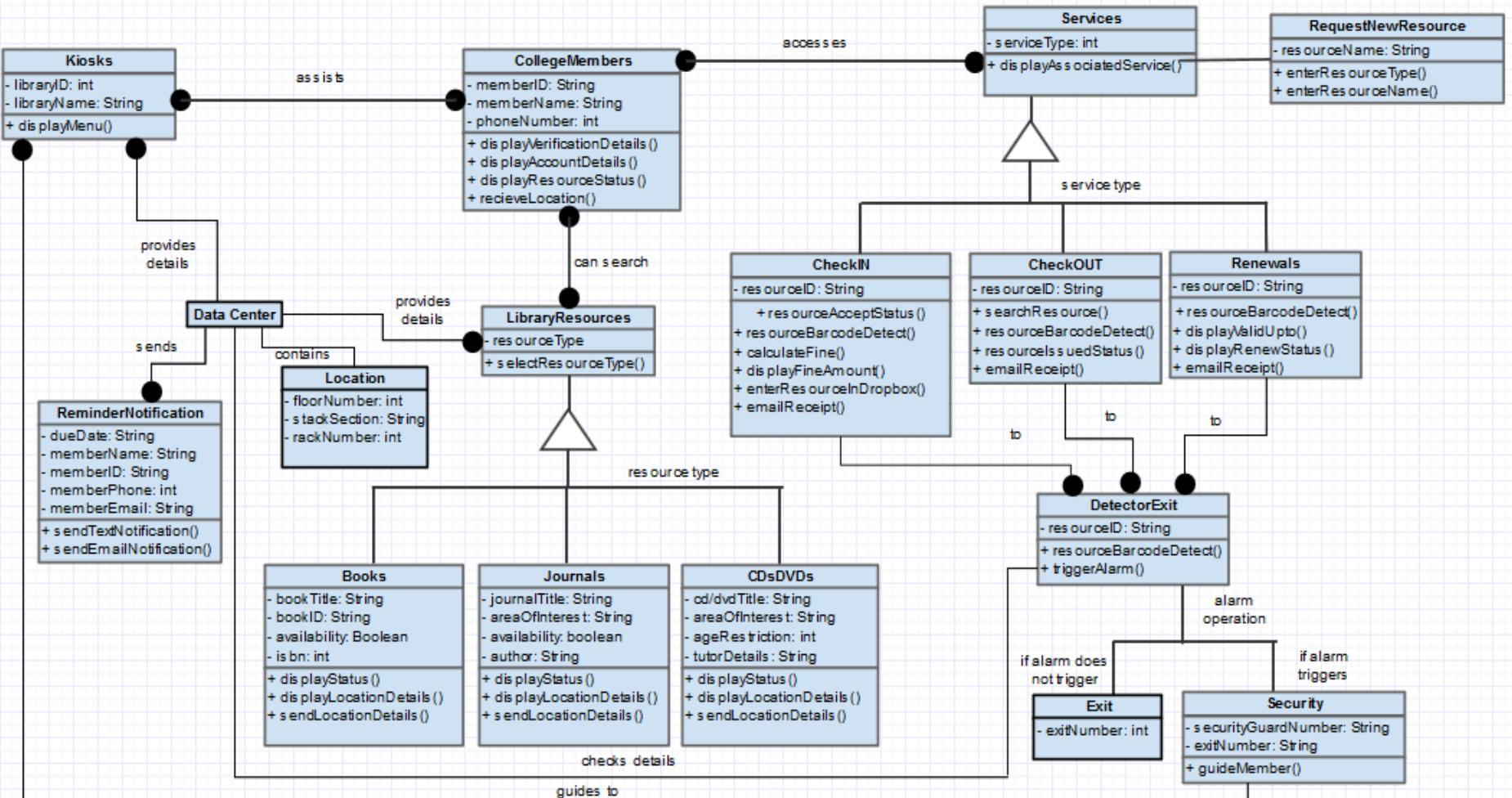


Figure 3: Object-Oriented Model

4.2 Dynamic Model

A dynamic model describes the time-dependent behavior of the system and the objects in it.

Normal scenario:

1. Kiosks ask the user to log in using his username and password or swipe his card
2. Kiosks read the given details and checks it with the member account in the database
3. Kiosk asks the user if he wants to search a resource example book using search prompt.
4. User searches for his desired book.
5. User can search on the kiosk as long as he wants.
6. When the user finds the required book, he can request the database to send the location of the book to his mobile phone.
7. The user can use the barcode reader to self-check-out the book.

After the allotted time period the user comes back to the library and can either check in the book or renew it.

Scenarios with Exceptions:

Case 1:

1. Kiosks ask the user to log in using his username and password or swipe his card.
2. The computer controlled system linked to kiosk reads the given details and checks it with the member account in the database.
3. If the records do not match with the database and hence re-prompts the user to log in to his member account.

Case 2:

1. The user comes to renew the book after the due date
2. The system puts a hold on the member user's account and asks him to pay the fine imposed, before renewing.
3. The kiosk provides a provision to pay the fine using a debit card or deposit coins in the coin collection box.

Case 3:

1. The user has checked in the book but he has not dropped it in the drop box.
2. The kiosk rings the alarm and calls for security to assist the user in dropping the book in the drop-box.

Case 4:

Request new resource:

- (a) When search flag for the same number of resource search exceeds 5 (i.e 5 times), then the system automatically asks the user to make a new resource request.
- (b) When the user wants a new book or resource, he can make a request at the kiosk itself.

Sequence Diagrams

Event trace diagram.

The event trace diagram traces the series of events that happen during a general use scenario.

In the following diagram, the event trace diagram covers four cases of checking in, checking out book, renewing it and making a new request for any book to the library.

Kiosks ask the user to log in using his username and password or swipe his card. It then reads the given details and checks it with the member account in the database.

Kiosk gives user four options - to search a book, check in a book, check out a book, renew a book and make a new request for a book. The user selects one of these options (let us say, search a book) -

User searches for his desired book in the search box and requests the kiosk to send the location of the required book. The kiosk then requests the database to send the location of the book to his (registered user's) mobile phone. Thus, the user can easily locate the resource in the library.

In case the user has already found the required resource, he can then use the barcode reader to self-check-out the book. After the allotted time period, the user comes back to the library and can either check in the book or renew it. In case, a same resource search is made more than five times, the database automatically redirects the user to make a new request and the request for that particular resource will be registered in the database (without making a new request separately). This makes the system more intelligent. Such an intelligent system keeps track of the searches performed by the users to meet the requirements of the college member users.

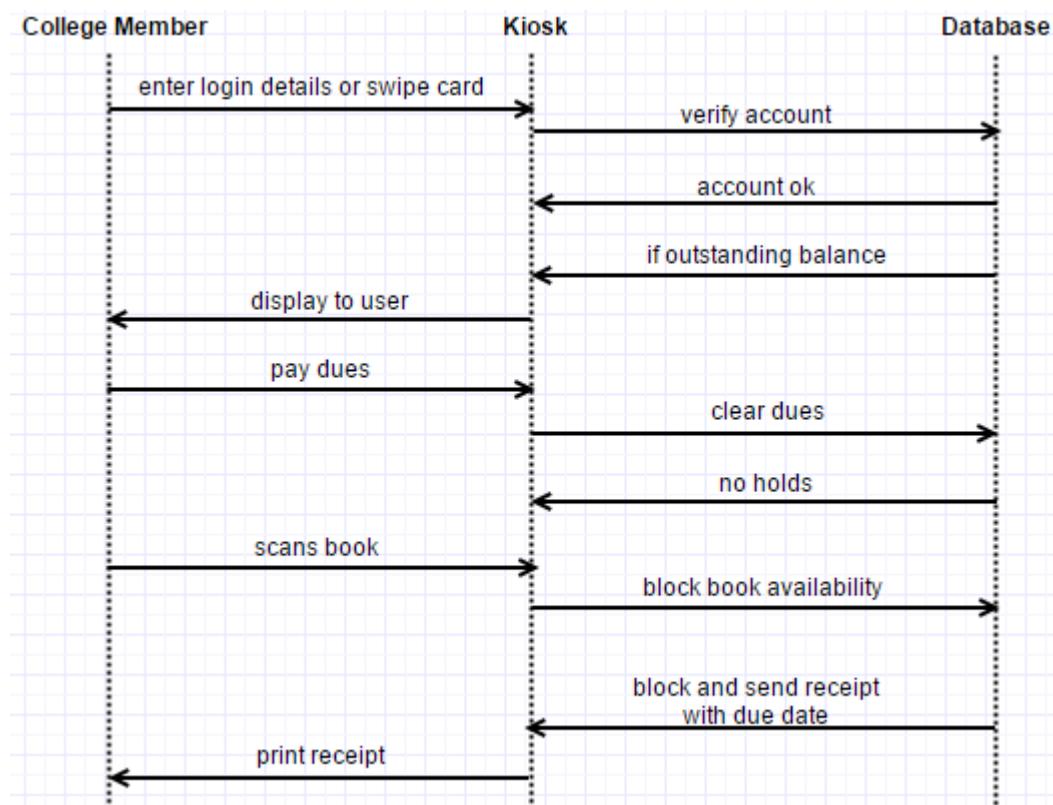
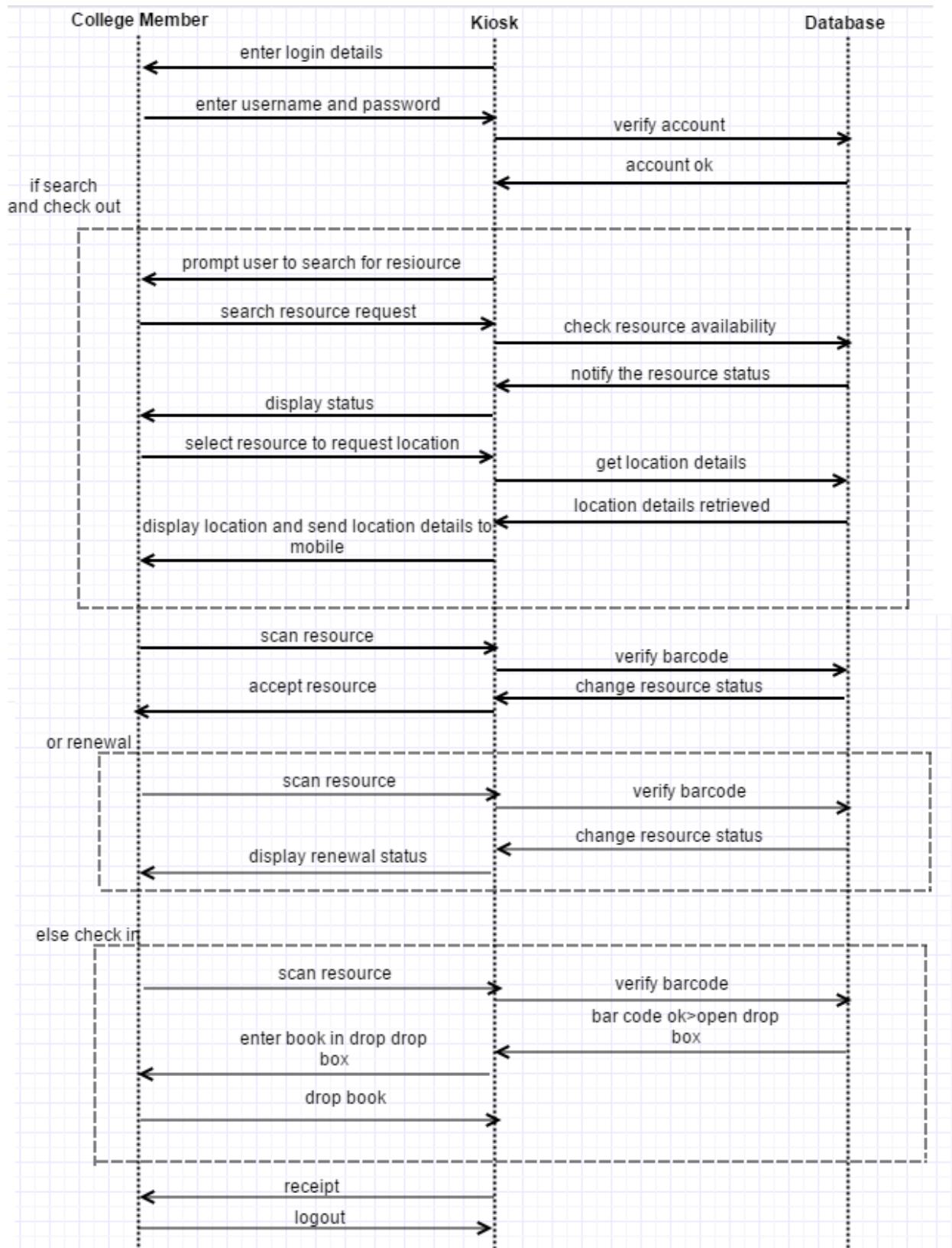


Figure 4: Sequence Diagram for Check-out



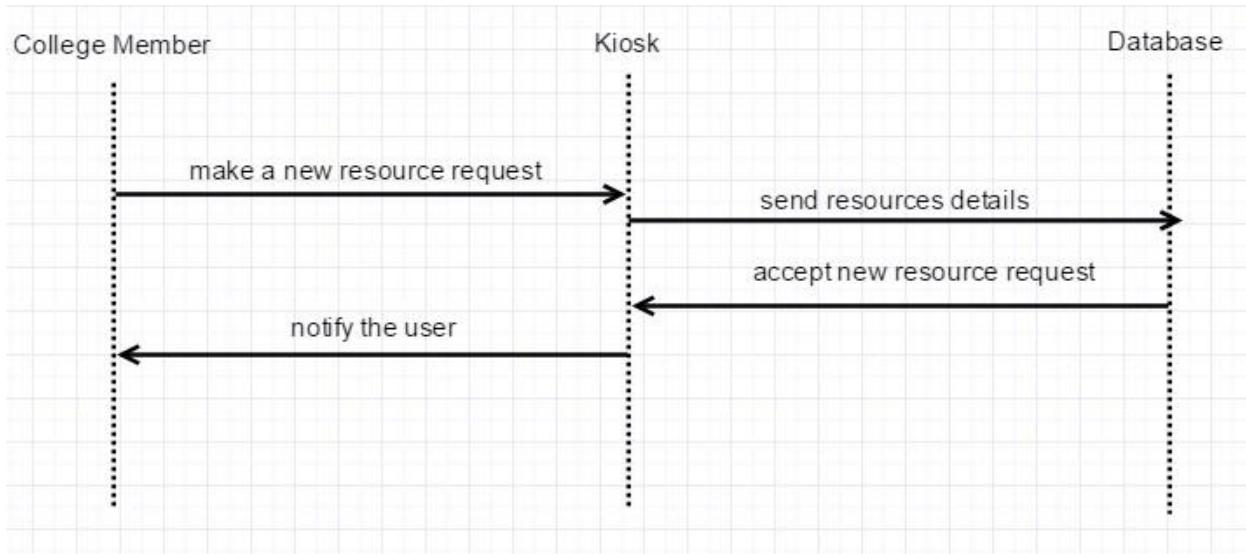


Figure 5: Event flow diagram

In the event flow diagram, the following exceptions can occur when the following system is used in real time. The types of exceptions that may occur are as follows:

1. The user inputs the wrong username or password. The kiosk asks the user to re-enter the credentials
2. The user tries to renew or get a new book (after the due-date has passed). The system will then put a hold on the account till the user pays the fine.
3. The user checks in the book and forgets to drop it in the drop box. The alarm rings and the security personnel will guide the user to drop it in the drop box

Activity diagram

This diagram depicts all the possible activities that can be performed by the system. (Figure 6)

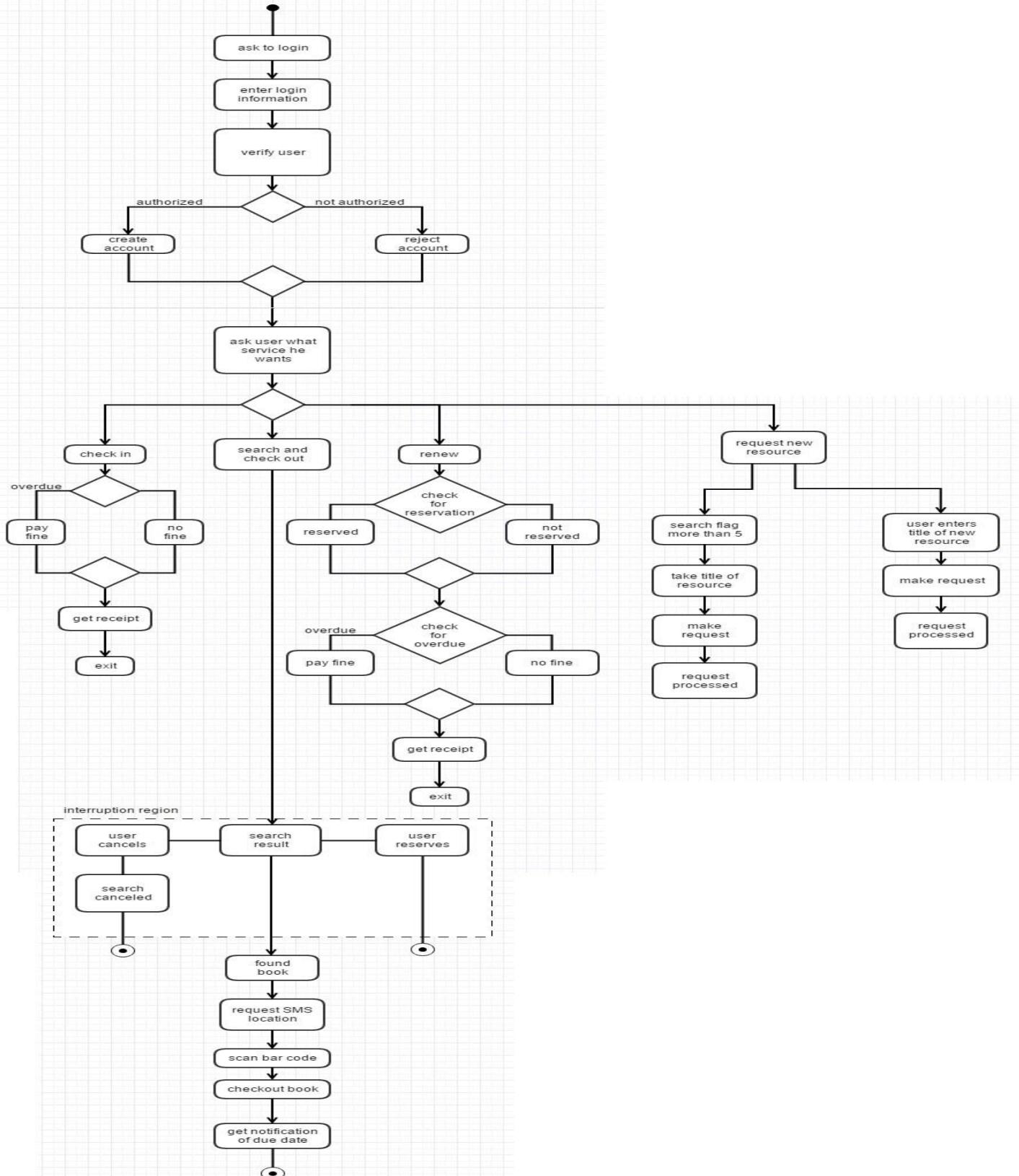


Figure 6: Activity Diagram

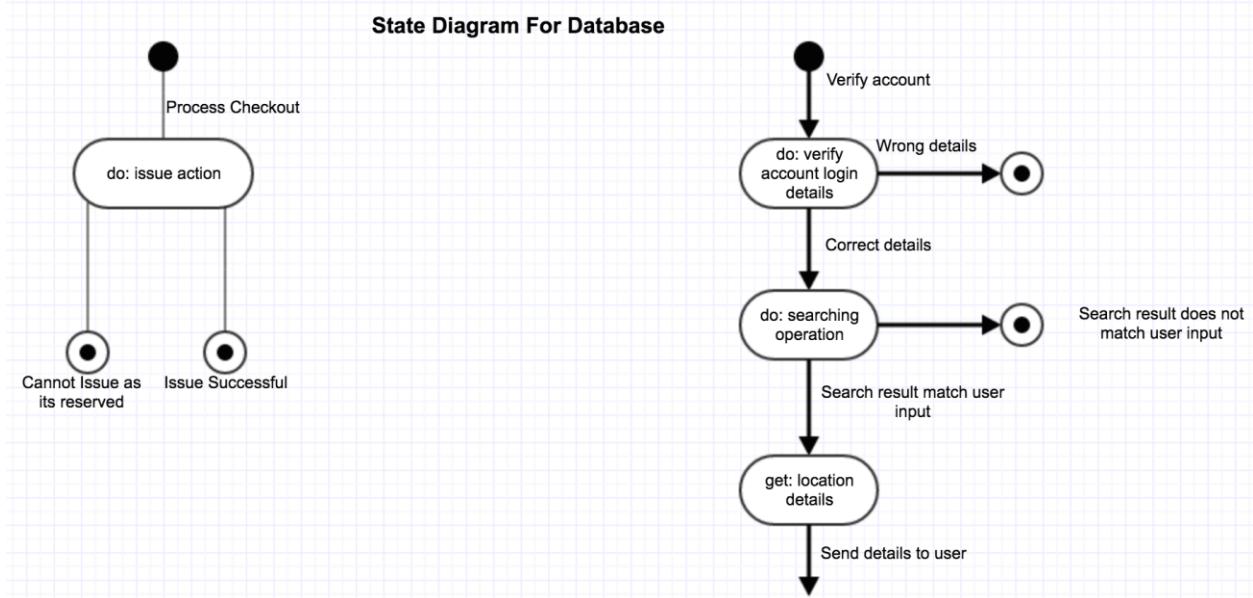


Figure 7a: State Diagram for Database

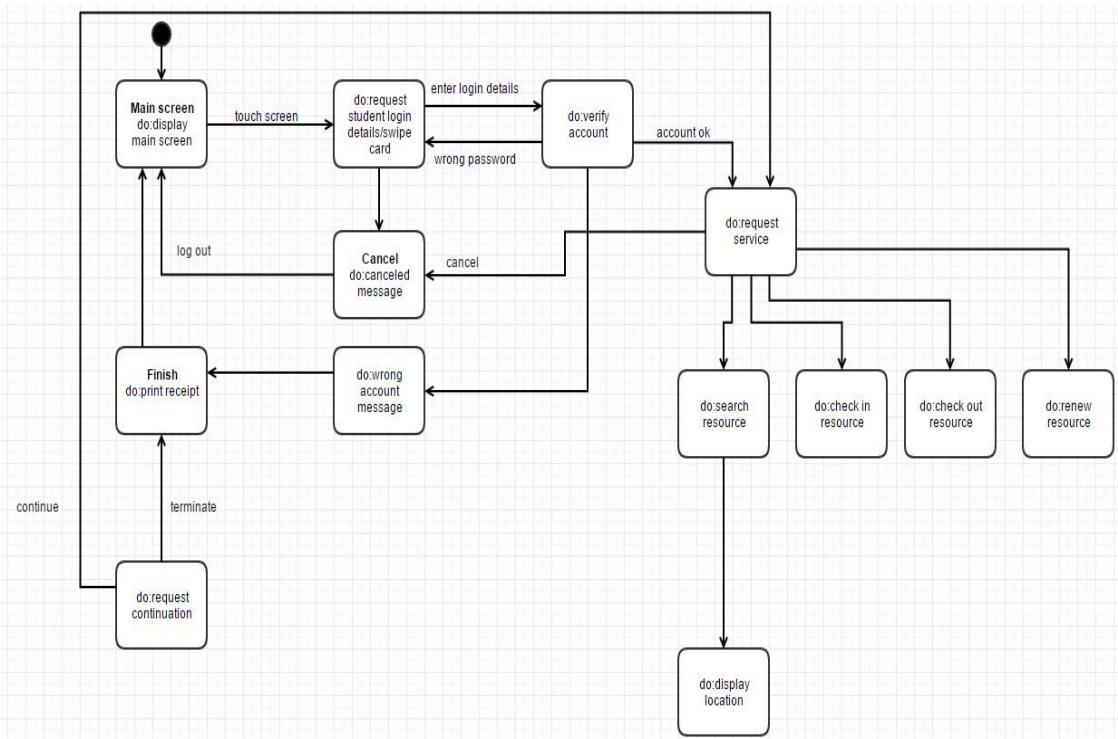
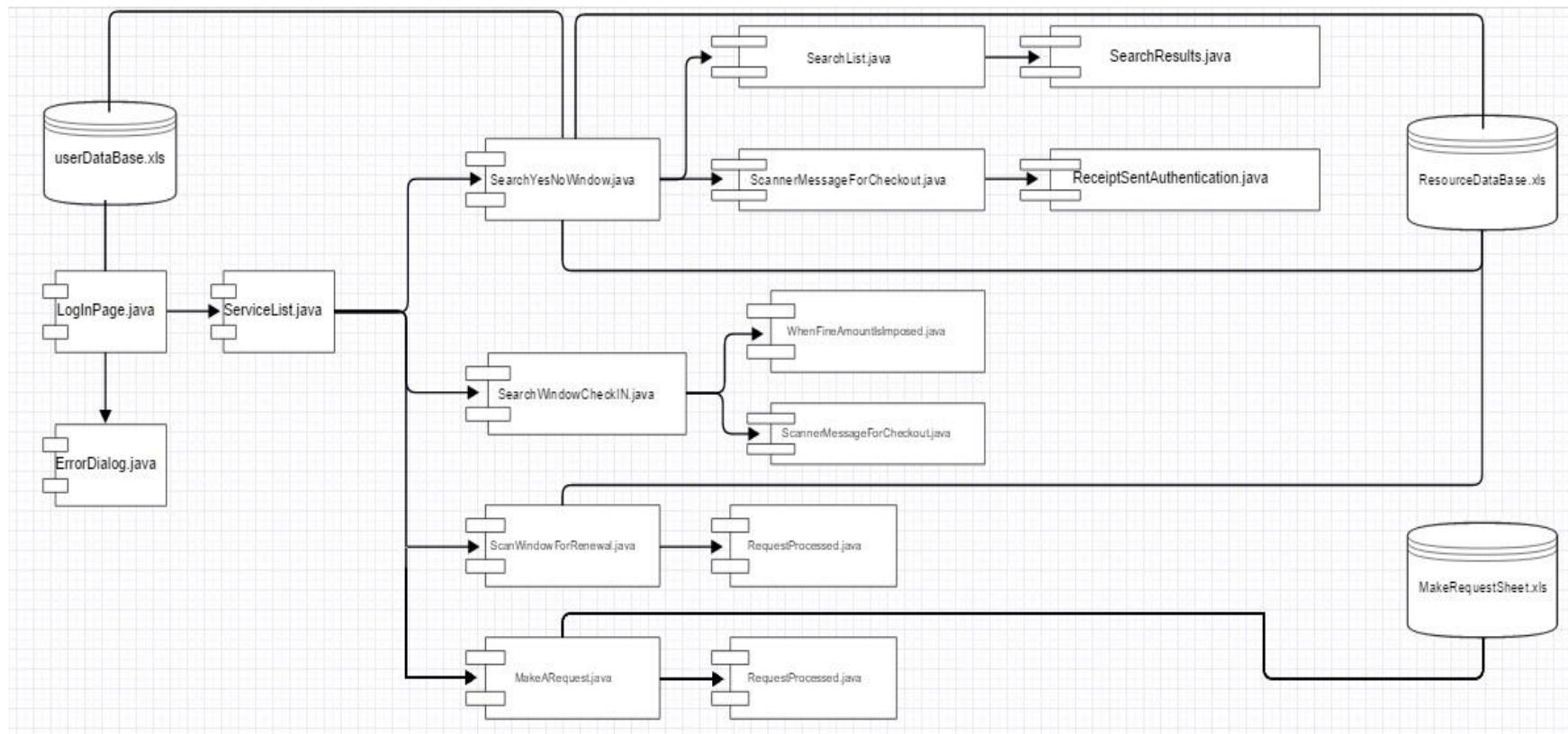


Figure 7b: State Diagram for Kiosk

5. SYSTEM ARCHITECTURE



The requirement of the library resource management system is to assist the college member user to handle the library resources without any hassle. To fulfill this requirement, the following components were identified:

Graphical User Interface

The GUI is an interactive window that aids the user to give the description of the resource that he is trying to locate in the library. GUI provides the user recommendations about where the object is located and how he can go about to retrieve it. It is then up to the user to take the recommendation.

Search Event class

In the search class, the user is given an option of entering the keyword associated with the resource he wants to search in the library. Typically such information includes resource type, resource name, and resource author. Once the user enters the keywords associated with the resource needed, the search class will provide a solution report showing the status of the items.

Search algorithm

Based on the keywords that the user inputs in the search event, the search algorithm processes the keyword and begins to search for the object in its database. This search algorithm is the main brain of the system which locates the relevant information in the database and retrieves it from the same.

Library database

This is the main memory component of the system that stores all the relevant data starting from the member details, password, account opening date, name of the resources, resource types, its location in the library, its issue status etc. All the information associated with the user, and the resources will be retrieved from this location and sent to the user. Also, this class stores the recent updates made in the system.

Library resource

The major target of our automated resource management system is the library resource. The library resources considered in our system are books, journals and CDs/DVDs. There are various services available to deal with the library resources.

Member

The user of the system is the member of the university. He will perform the search operation. Based on the results that he gets, he decides to conduct re-search or go and find that resource by himself.

Transaction

If a library resource is overdue then there will be a transaction component that depends on how long it has been overdue. Depending on the number of days that have crossed the due date deadline, it will generate a bill and give it to the user and the user will have to pay the overdue fine as a penalty.

6. APPLICATION SCENARIO (DEMO SCENARIO)

Let us consider a member, Allen. He wants to get a book named “JAVA: The complete reference”, Seventh edition, from the library. He comes to the kiosk and uses the GUI in the kiosk to search for the book. He performs a search event by typing the title of the book. The search event sends it to search algorithm which breaks the title into keywords and searches in the database and gives the search results on the GUI screen. It asks Allen whether he wants the resource location or not. If the book is available and Allen wants it, then he requests for the location of the book to be sent to his registered mobile phone. The search algorithm will search for Allen’s phone number in the database and will send a text notification to Allen. Allen receives the text message which gives him the directions to reach the book and checks out the book. After he checks out the book, the book will be booked under Allen’s name, in the database and the database system will wait till Allen returns the book. Also, it will keep track of the number of days for which the book will be issued. When Allen comes to check in the book, the search algorithm will search for Allen’s account and calculates the fine that is imposed on the book, if it is overdue. It then displays the fine and asks Allen to pay it before carrying out any other transaction at the kiosk. If no fine is imposed, the user is free to choose the service he wants and go ahead with the same, at the kiosk.

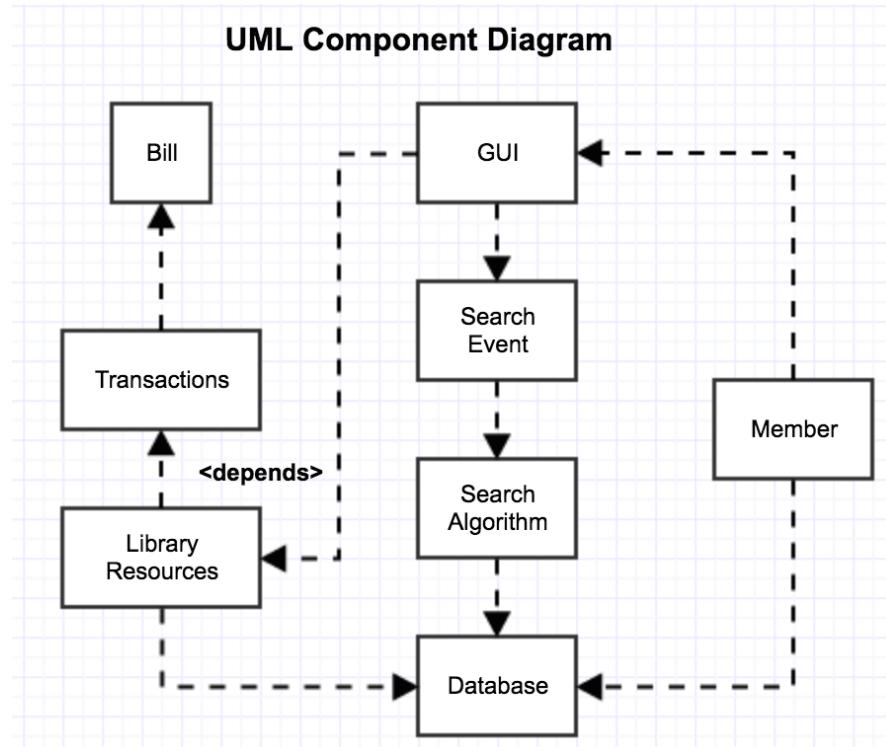


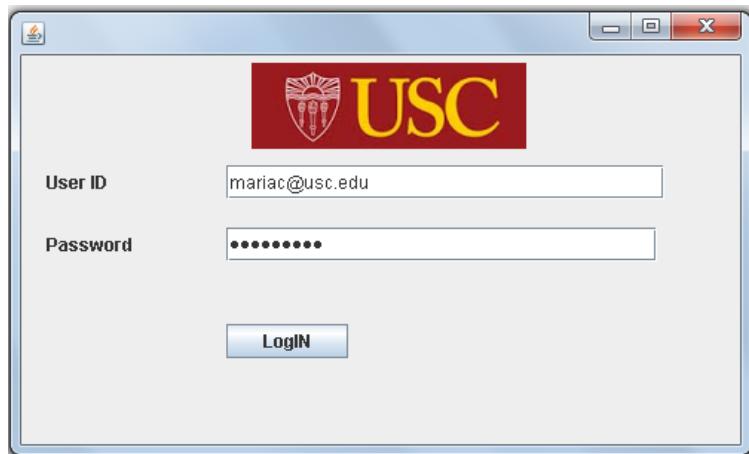
Figure 8: UML Component diagram for the Library Resource Management System

7. SYSTEM TESTING AND EVALUATION

- When you type in the wrong User ID or Password, an error message pops up that lets you know that you have entered the wrong details.



- When you type in the correct username and password, you can log in to your account and perform the necessary operations.



- An Excel sheet contains all the relevant details of the members of the library such as their email address, password, contact number, first and last names, date of birth, the resource that they have issued, the date when they issued the resource and the due date along with the fines (penalty), if they have the resource past the due date.

| | A | B | C | D | E | F | G | H | I | J | K |
|----|-------------------|-----------|----------------|------------|-----------|-----------|------------|-------------|---------------------------------------|---------------|---|
| 1 | Email ID | Password | Contact Number | First Name | Last Name | Member ID | DOB | Resource ID | Resource Issued | Date of Issue | |
| 2 | john@usc.edu | xyz | 2156238970 | John | Anderson | 6819053 | 16/05/1994 | 3 | A Brief History of Time | 13-01-2016 | |
| 3 | david@usc.edu | lion | 2156238990 | David | Smith | 9875462 | 19/08/1993 | 5 | Organic Chemistry | 10-01-2016 | |
| 4 | helen@usc.edu | tiger | 215687420 | Helen | Parker | 6235661 | 10-09/1993 | 7 | PMP Certification Mathematics | 23-03-2016 | |
| 5 | fisher@usc.edu | cat | 2156239018 | Fisher | Gareth | 5465621 | 09-02/1992 | 10 | Chemistry Matter and Change | 12-02-2016 | |
| 6 | mary@usc.edu | dog | 2156239032 | Mary | Garcia | 6565645 | 01-06/1994 | 1 | Oxford Dictionary of Chemistry | 11-03-2016 | |
| 7 | jack@usc.edu | tin | 2156239046 | Jack | Laker | 1564896 | 05-03/1994 | 6 | Principles of Mathematics | 26-03-2016 | |
| 8 | miahari@usc.edu | saber | 2135461256 | Mia | Harris | 6485645 | 11-12/1992 | 2 | Linear Programming in Mathematics | 02-04-2016 | |
| 9 | robertp@usc.edu | light | 2156239074 | Robert | Pattinson | 5654089 | 12-11/1993 | 15 | The Grand Design | 01-03-2016 | |
| 10 | neilmcc@usc.edu | whitnac | 2156239088 | Neil | McCarthy | 4659689 | 30-07/1994 | 11 | Foundation Physics | 16-02-2016 | |
| 11 | lewiela@usc.edu | fuddle | 2156239102 | Lewis | Lane | 5690320 | 15-10-1992 | 12 | Physics Quantum Enigma | 31-03-2016 | |
| 12 | brucew@usc.edu | popsicle | 2156239116 | Bruce | Willis | 9654945 | 06-07/1995 | 13 | The Theory of Everything | 01-01-2016 | |
| 13 | gregory@usc.edu | flight | 2156239130 | Gregory | Houston | 4546798 | 25-04-1992 | 8 | Physics Mechanics | 02-02-2016 | |
| 14 | mariac@usc.edu | shipwreck | 2132654785 | Maria | Campbell | 7897469 | 20-03/1993 | 9 | Vector Algebra | 31-12-2015 | |
| 15 | ricardow@usc.edu | guatem | 8546215420 | Ricardo | Vinci | 4562565 | 16-04/1993 | 20 | Parallel Worlds | 11-11-2015 | |
| 16 | caitlyn@usc.edu | windy | 8584621879 | Caitlyn | Stark | 5630135 | 11-02/1993 | 18 | Textbook of Organic Chemistry | 13-01-2015 | |
| 17 | vanessa@usc.edu | guarded | 2636556785 | Vanessa | Dmello | 5614658 | 12-03/1993 | 14 | Advanced Engineering Mathematics | 04-03-2016 | |
| 18 | rudygu@usc.edu | annotate | 5689405656 | Rudy | Guardo | 5456980 | 16-12-1992 | 63 | Applied Physics | 01-06-2016 | |
| 19 | mariasa@usc.edu | sumpt | 5669084205 | Maria | Sanchez | 7896642 | 15-01-1994 | 54 | Sound and Structural Vibration | 04-03-2016 | |
| 20 | vindust@usc.edu | quit | 2301565966 | Vin | Dustin | 6543217 | 19-01-1993 | 28 | Mass Transfer in Chemical Engineering | 24-03-2016 | |
| 21 | gusting@usc.edu | moose | 6543219871 | Gustin | Grant | 7532428 | 12-01-1993 | 35 | Introductory Chemical Engineering The | 02-06-2016 | |
| 22 | paulmc@usc.edu | mousse | 3215487963 | Paul | Mccartney | 9518470 | 20-04-1993 | 34 | Atoms and Molecules | 31-01-2016 | |
| 23 | pearlarn@usc.edu | cupcake | 3218549870 | Pearl | Ambers | 6325871 | 15-10-1992 | 21 | A Textbook of Engineering Physics | 02-06-2016 | |
| 24 | amandap@usc.edu | fire | 7894561230 | Amanda | Prune | 2103654 | 03-08-1991 | 26 | Engineering Mathematics | 21-03-2016 | |
| 25 | stephen@usc.edu | watch | 3258741960 | Stephen | Amell | 9871230 | 19-08-1991 | 19 | Principles of Plasma Physics | 20-04-2016 | |
| 26 | bobfull@usc.edu | ginger | 9856412370 | Bob | Fuller | 9854605 | 11-01-1994 | 45 | Functions, Spaces and Expansions | 30-03-2016 | |
| 27 | emilyrich@usc.edu | light | 2105463987 | Emily | Richards | 1236548 | 02-08-1993 | 33 | History of Chemical Engineering | 03-03-2016 | |
| 28 | emmawat@usc.edu | cranium | 6541239870 | Emma | Watson | 2546981 | 16-06-1994 | 14 | Basic Engineering Mathematics | 18-03-2016 | |
| 29 | fredweas@usc.edu | spine | 9854126370 | Fred | Weasley | 3254186 | 18-10-1992 | 90 | Quantum Series | 26-03-2016 | |
| 30 | | | | | | | | | | | |

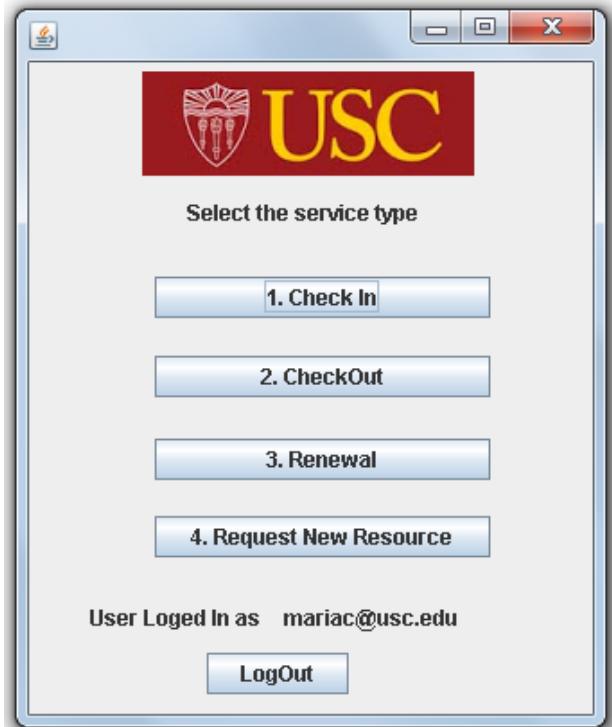
Specific Student Details

| Email ID | Password | Contact Number | First Name | Last Name | Member ID | DOB |
|----------------|-----------|----------------|------------|-----------|-----------|------------|
| mariac@usc.edu | shipwreck | 2132654785 | Maria | Campbell | 7897489 | 20-03-1993 |

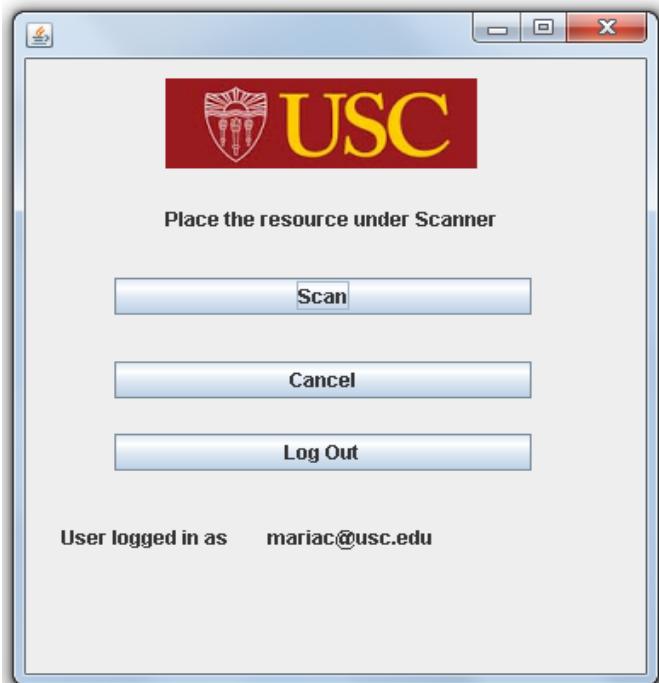
4. Types of services offered

This window holds the following options:

- If you have a resource and want to return it, you can select the first option, that is, Check In.
- If you want to search for a resource or take a resource, you can select the next option, which is Check Out.
- The third option is Renewal. It can be used when the user wants to renew a pre-issued resource.
- The fourth option, Request New Resource, is an option when there isn't a resource in the library and you would like to suggest the university to buy that resource. Thus, making a new resource request to the library resource management system.



5. When Check In is selected, the user has three options, where he/she can scan the resource that they're returning to the library.

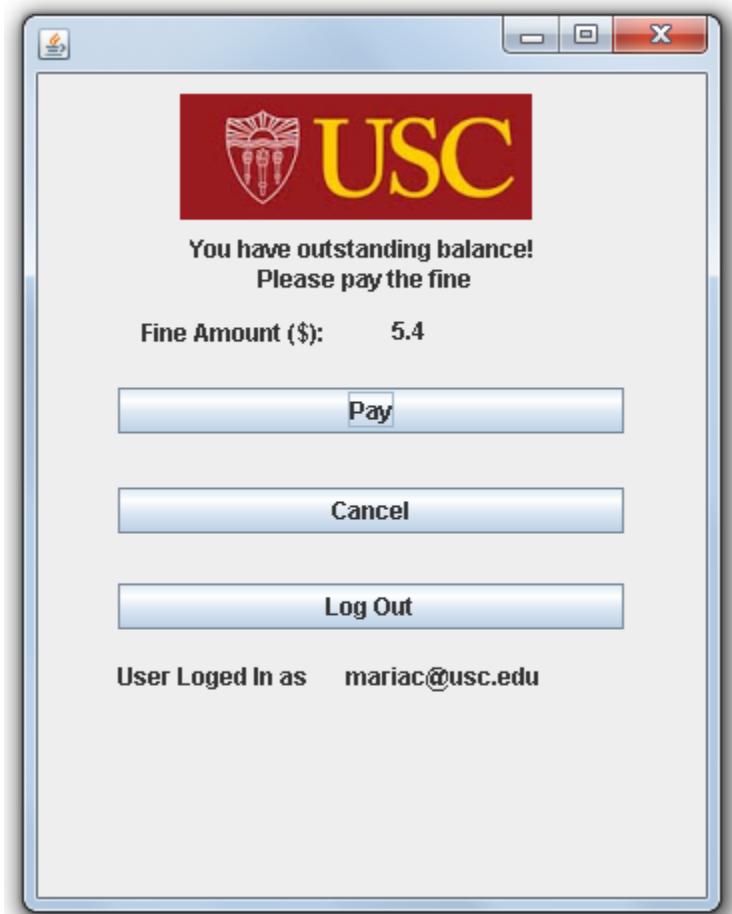


When the user hits the Cancel button, he/she is directed to the Main Menu (Services Menu)
When the user hits the Logout button, the user gets logged out of the system

6. When the User hits the Scan button, the excel sheet will calculate the fine (penalty), depending upon the delay time. He will be asked to pay the fine and on doing so, he will be directed to the window in step number 7.

| Email ID | Password | Contact Number | First Name | Last Name | Member ID | DOB | Continue |
|----------------|-----------|----------------|------------|-----------|-----------|------------|----------|
| mariac@usc.edu | shipwreck | 2132654785 | Maria | Campbell | 7897489 | 20-03-1993 | |

| Continue | Resource ID | Resource Issued | Date of Issue | Due Date | Date Returned | Days Late | Late? | Fine |
|----------|-------------|-----------------|---------------|------------|---------------|-----------|-------|--------|
| | 9 | Vector Algebra | 31-12-2015 | 02-04-2016 | 29-04-2016 | 27 | TRUE | \$5.40 |



7. If the resource is returned within the due date, no fine (penalty) will be imposed and the user will be directed to the window mentioned below. Also, after paying the fine due (in cases), the user will be directed to this window.



The database undergoes the following change when the fine is paid

| Email ID | Password | Contact Number | First Name | Last Name | Member ID | DOB | Continue |
|----------------|-----------|----------------|------------|-----------|-----------|------------|----------|
| mariac@usc.edu | shipwreck | 2132654785 | Maria | Campbell | 7897489 | 20-03-1993 | |

| Continue | Resource ID | Resource Issued | Date of Issue | Due Date | Date Returned | Days Late | Late? | Fine |
|----------|-------------|-----------------|---------------|------------|---------------|-----------|---------|--------|
| | 9 | Vector Algebra | 31-12-2015 | 02-04-2016 | 29-04-2016 | #VALUE! | #VALUE! | \$0.00 |

8. When the user hits the Check Out button in the Main Menu, he/she is directed to the following menu



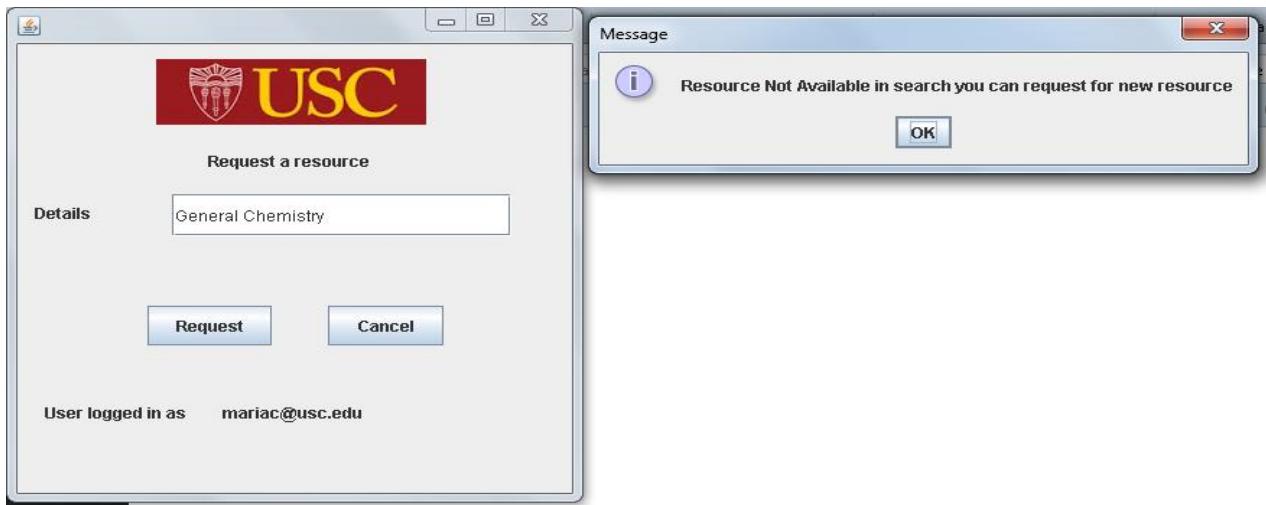
- When the user wants to search for a resource and clicks the Search button but gives the wrong input, the system displays a message that states, "Wrong keywords Search again".

10. When the user searches for a resource that may not be available, and has been searched many times by other users, the search flag index is incremented each time when that particular resource is requested.

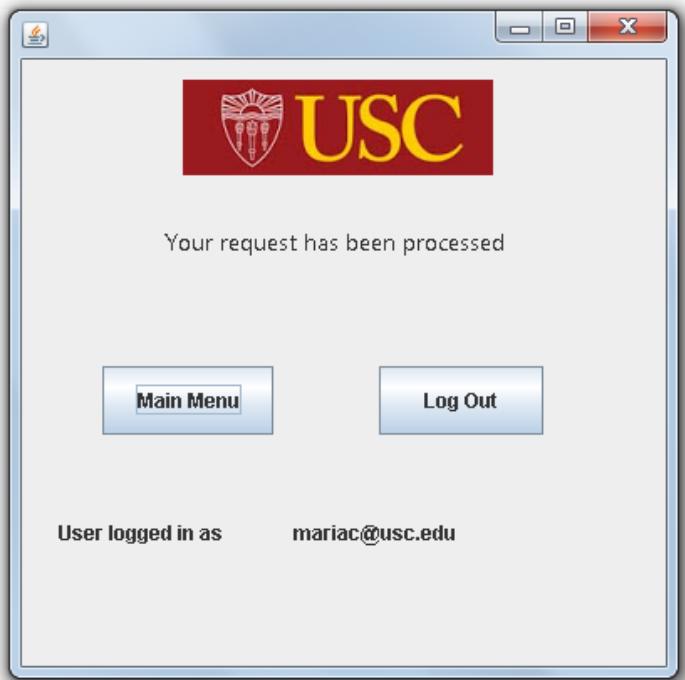
| Resources DataBase [Compatibility Mode] - Microsoft Excel | | | | | | | | | |
|---|----------------------|-----------|--------------------------------------|---------------------------|---------------------|-----------------|--------------------|---|---|
| | E | F | G | H | I | J | K | L | M |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | Resource Type | ID | Title | Author/Publication | Availability | Location | Search Flag | | |
| 9 | Book | 1 | Concepts of Physics | Verma | NA | 101_A10_R5 | 7 | | |
| 10 | Book | 2 | IIT JEE Physics | Verma | NA | 109_B9_R2 | 0 | | |
| 11 | Book | 3 | A Brief History of Time | Hawking | AV | 102_F8_R3 | 0 | | |
| 12 | Book | 4 | General Chemistry | Pauling | NA | 105_C5_R6 | 10 | | |
| 13 | Book | 5 | Organic Chemistry | Clayden | AV | 101_T6_R2 | 0 | | |
| 14 | CDsAndDVDs | 6 | Friendly Chemistry DVD Series | Hajda | AV | 103_Z4_R1 | 0 | | |
| 15 | CDsAndDVDs | 7 | PMP Certification Mathematics | Subramanian | AV | 106_S4_R3 | 0 | | |
| 16 | CDsAndDVDs | 8 | The Great Math Mystery | NOVA | AV | 109_G6_R7 | 0 | | |
| 17 | Journal | 9 | Journal of Heat Transfer | ASME | AV | 108_G5_R3 | 0 | | |
| 18 | Journal | 10 | Journal of Turbomachinery | ASME | NA | 102_Y5_R2 | 0 | | |
| 19 | Journal | 11 | Plasma Physics and Controlled Fusion | IOPScience | NA | 100_F4_R1 | 0 | | |
| 20 | Book | 12 | A Transition to Advanced Mathematics | Johnston | AV | 101_Q7_R4 | 0 | | |
| 21 | Book | 13 | Mathematical Programming | Hu | NA | 103_F1_R4 | 11 | | |
| 22 | Book | 14 | A Mind For Numbers | Oakley | AV | 102_H9_R3 | 0 | | |
| 23 | CDsAndDVDs | 15 | Experiencing Hubble | Meyer | AV | 104_L8_R1 | 0 | | |
| 24 | CDsAndDVDs | 16 | My Favorite Universe | Tyson | AV | 107_O3_R2 | 0 | | |
| 25 | CDsAndDVDs | 17 | Masterworks of American Art | Kloss | AV | 108_T3_R5 | 0 | | |
| 26 | Journal | 18 | Archives of Scientific Psychology | Reynolds | AV | 106_D4_R2 | 0 | | |

| Resource Type | ID | Title | Author /Publication | Availability | Location | Search Flag |
|----------------------|----|-------------------|---------------------|--------------|-----------|-------------|
| Book | 4 | General Chemistry | Pauling | NA | 105_C5_R6 | 10 |

11. When the search flag exceeds 5, the system automatically redirects the user to make a new request (as the resource name is already registered in the database). Thus, user can make a new request if necessary.



12. The following authentication window stating the request is processed, pops up when the user finishes requesting a resource.



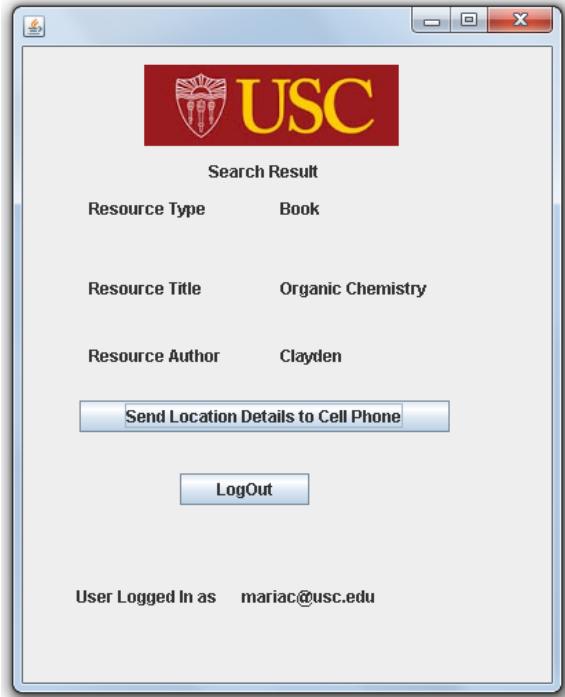
13. When the user hits the Request New Resource button, the system logs the request in the make new request excel sheet that keeps track of all the new resource requests made.

| makeRequestSheet [Compatibility Mode] - Microsoft Excel | | | | | | | | | | |
|---|-----------------|--------------------------|-------|----------------|------|------|------|------|------|------|
| File Home Insert Page Layout Formulas Review View | | | | | | | | | | |
| | Cut | Copy | Paste | Format Painter | Font | Font | Font | Font | Font | Font |
| | Font | Font | Font | Font | Font | Font | Font | Font | Font | Font |
| | Font | Font | Font | Font | Font | Font | Font | Font | Font | Font |
| 1 | A | B | C | D | E | F | G | H | I | J |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | Email ID | Resource requested | | | | | | | | |
| 9 | jack@usc.edu | General Chemistry | | | | | | | | |
| 10 | fisher@usc.edu | Power Electronics | | | | | | | | |
| 11 | amandap@usc.edu | Probability | | | | | | | | |
| 12 | mary@usc.edu | Concepts of Physics | | | | | | | | |
| 13 | john@usc.edu | Mathematical Programming | | | | | | | | |
| 14 | mariac@usc.edu | General Chemistry | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | |

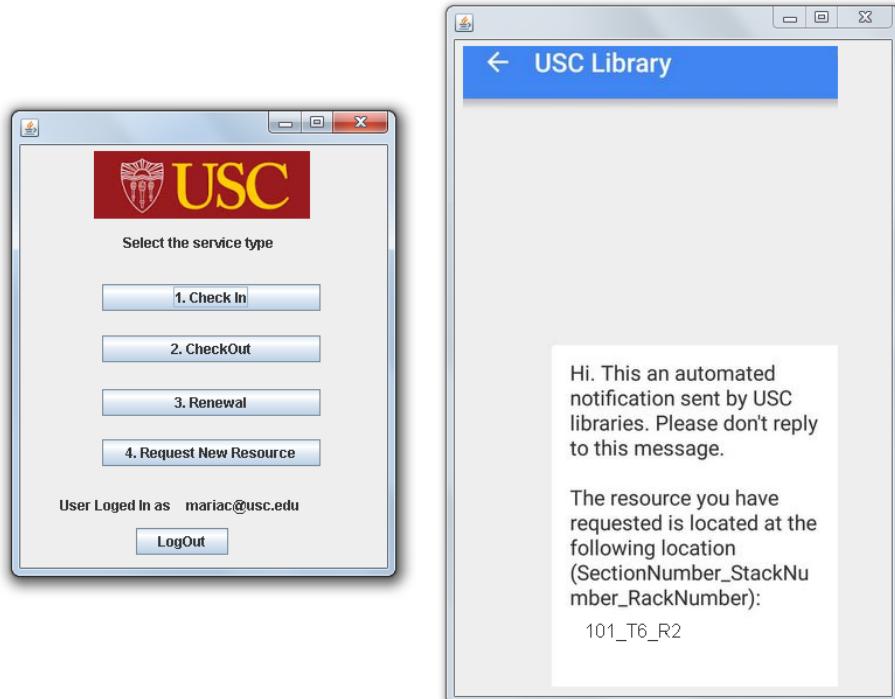
14. When the resource is actually available, the user can input information pertaining to the resource type, title and author and search for it.

The screenshot shows a search interface titled "SEARCH LIST". It includes fields for "Resource Type" (Book), "Resource Title" (Organic Chemistry), and "Resource Author" (Clayden). Below these fields is a "Search" button. At the bottom, it displays "User Logged In as mariac@usc.edu" and features "Logout" and "Cancel" buttons.

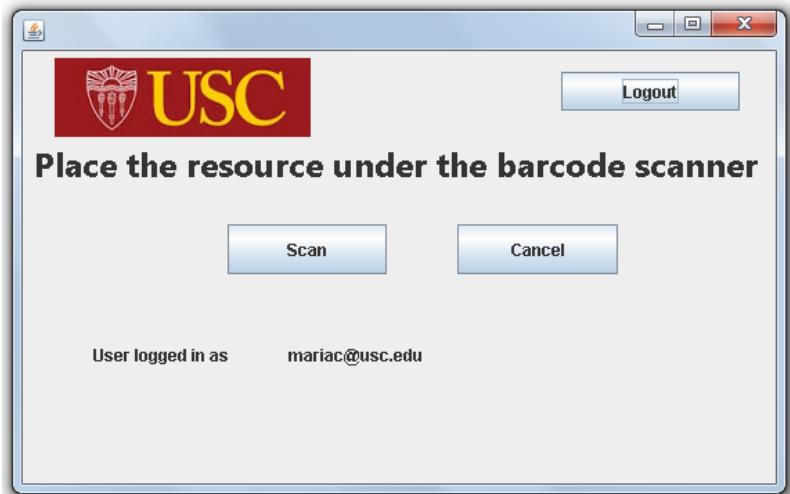
15. The user is shown an Availability message as shown.



16. The user can then ask the system to send the location to his cell phone, and the library then sends the details of the location to his mobile device.



17. Once the user has found the resource he wants, he can check-out the resource at the kiosk. The kiosk asks the user to place the resource under the barcode scanner (as shown below):



18. In order to simulate a barcode scanner, a random number is generated such that it issues a resource to the user and the following window is seen by the user.



The receipt will be sent to the user's email account stating when the resource is due along with other details.

19. When the person wants to renew an existing resource, he/she can hit the Renewal button. They are then asked to scan the resource under the barcode scanner and when done, he/she will get an authentication message stating that the resource has been renewed.



20. When the user wants to request the library for a new resource that is not available, he chooses the fourth option and directed to the following window, where he can enter the details related to the resource.



It is similar to requesting a resource when the flag count exceeds 5. But here, the user can enter whatever he wants, and the system will take the corresponding user input into account. The system uses this input and registers it in the make new request excel sheet that keeps track of all the new entries made in the system.

21. Make New Request Excel Sheet has information regarding the user email ID and the resource that the user has requested.

| | Email ID | Resource requested |
|----|-----------------|--------------------------|
| 8 | jack@usc.edu | General Chemistry |
| 9 | fisher@usc.edu | Power Electronics |
| 10 | amandap@usc.edu | Probability |
| 11 | mary@usc.edu | Concepts of Physics |
| 12 | john@usc.edu | Mathematical Programming |
| 13 | mariac@usc.edu | General Chemistry |
| 14 | mariac@usc.edu | Big Java |
| 15 | | |
| 16 | | |
| 17 | | |
| 18 | | |
| 19 | | |
| 20 | | |
| 21 | | |
| 22 | | |

- **INTELLIGENT BEHAVIOR**

The following intelligent behaviors are available in our system they are

- a. Location Retrieval
- b. Automatic request for new resource when search flag exceeds a certain limit (say 5)
- c. The user can also make separate new request
- d. Fine Payment can be done at the kiosk
- e. Search resource at the kiosk

8.FUTURE EXTENSIONS

- We can use neural networks and data mining to make our system more intelligent. For example, the system can collect a semester wide data and learn from the patterns of resource selection (that are made by the users) and register requests, if the user is finding difficulty getting resources.
- The system can be made even intelligent by feeding data about the courses (the user has taken) and accordingly suggest him what resource he can borrow from the library. If the prescribed resource for that particular course is not available, then the library should suggest alternative resources.
- Retrieval of location can be further improved to a whole new level. We can make a 3-D model of the entire library and make a localized positioning system for the user and record the local position of resources in the model and give the user real-time feel of knowing where the resource is located when he searches the library database.
- A provision to check out multiple books at a time. Say, provision for a maximum of three books per user can be implemented.
- Instead of excel SQL database can be used.

9.LESSONS LEARNT

- Creating object oriented model by using OMT for solving an engineering problem.
- Using Object model in coding which saves a lot of time and effort.
- We understood how useful eclipse IDE is in developing java applications.
- Coding and Debugging in Java.
- Use of Jigloo (Creating GUI & Linking GUI).
- Efficiently using Apache POI to read and write from Excel files.
- Use of eUML2 to create Object Models in Eclipse.

10. CONCLUSION

The automatic library resource management system is created to ease the entire system of acquiring a resource from the library by eliminating most of the interference by human beings, thereby reducing the errors and increasing the effectiveness. It should also be able to offer the members of the library the right kind of services (like check-in, check-out resources, locating resources in the stacks, finding the availability of the resources, requesting new resources, and offering security provisions to make the system robust). Also, the member plans can be renewed at the kiosks in our newly proposed system. The management system is also to generate an online portal and help member users to be linked to the data entry staff as well. The goal of the project is to provide an automatic, simple, secure and efficient resource management system. The system is specifically meant for university libraries and is targeted towards the students and faculty members of the university.

11. REFERENCE

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- Foundations of programming: Object Oriented Design by Simon Allardice (www.lynda.com)
- Java essential training by David Gassnar (www.lynda.com)
- Simple sketch and diagramming software Glify