**Social Library Web Application**

**Introduction**

The social library web app is based on the idea of real library with an additional feature of connecting likeminded book lovers with each other. The library has two sections: personal and social. A user can add new books to his personal library. Moreover, he can search and delete books from the personal library or edit them. Furthermore, books in the personal library can be viewed based on topics/metadata tags. Each book relates to a topic, therefore, when a user selects a topic then all the books under that topic are displayed to the user. In addition to personal section, the library has a social section where books from other users are recommended by the application. The recommendations are shown when a user has three books in common with another user of the library.

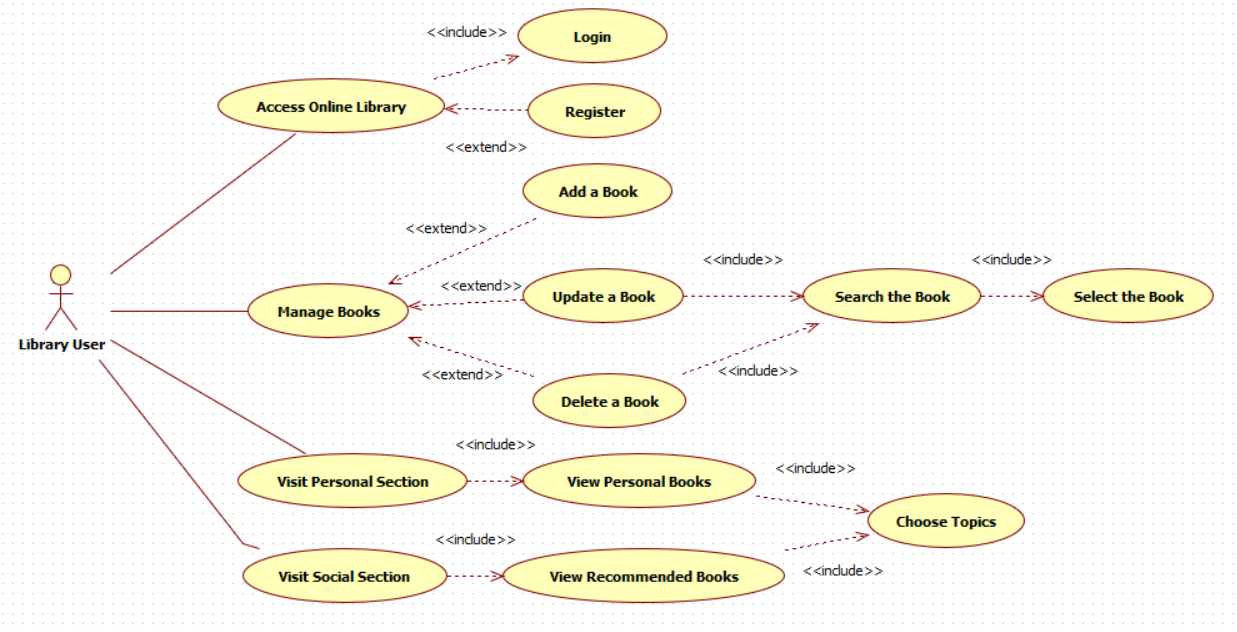
**Tools and Technologies**

For front-end design, we have used HTML, CSS and JavaScript with front-end library (jQuery [1]). Regarding the front-end frameworks, we have used Bootstrap [2], which is a free open-source CSS framework aimed at responsive, mobile first front-end web development. For back-end development, we used Node.js [3] which is an open-source, event driven asynchronous I/O famous for building efficient and scalable web servers. We chose Node.js because of the two main advantages, also highlighted by [4]. First, due to familiarity with JavaScript because of its status as an accepted standard for web development. Second, due to the fact that the use of one language for both front and back end development speeds up the coding since the developers’ brain does not need to switch between different syntaxes. In addition, we have used Express.js framework [5] that is designed for building web applications and APIs.

Regarding the database choice, we opted for MongoDB [6], which is a schema-less, document-based, general purpose, distributed database build for the cloud era, focused on modern application developers. MongoDB fascinates us because it uses a JavaScript interface that completes full-stack JavaScript stack puzzle of server, browser and database layers. As a result, we can use one language for all of the three layers. [4] also attributed this as a significant advantage of using MongoDB in addition to its performance and scaling. With regards to tools for application development, we have used IntelliJ IDEA [7] and NoSQLBooster [8].

**Use Case Diagram**

The use case diagram shown in the figure 1, describes the use cases (a set of actions) that can be performed by the users of our online social library app. The terms include and extend represent the relationship between the two use cases. The include relationship indicates that the included use case is necessary to be performed before performing including (base) use case. For instance, “Update a Book” is an including (base) use case but it incomplete without “Search the Book” and “Select the Book”, which are included use cases. The user first has to search and then select a book in order to perform update operation. The same goes for the use cases “View Personal Books” and “View Recommended Books”. First, the user has to choose topics / metadata tags for which she wants to view the personal or recommended books and only then the books would be displayed to her. The extend relationship, on the other hand, defines the optional behavior. For example, if a user wants to “Manage Books” then he might or might not “Update a Book”. It is not necessary that the extended use case is always performed to complete the extending (base) use case.

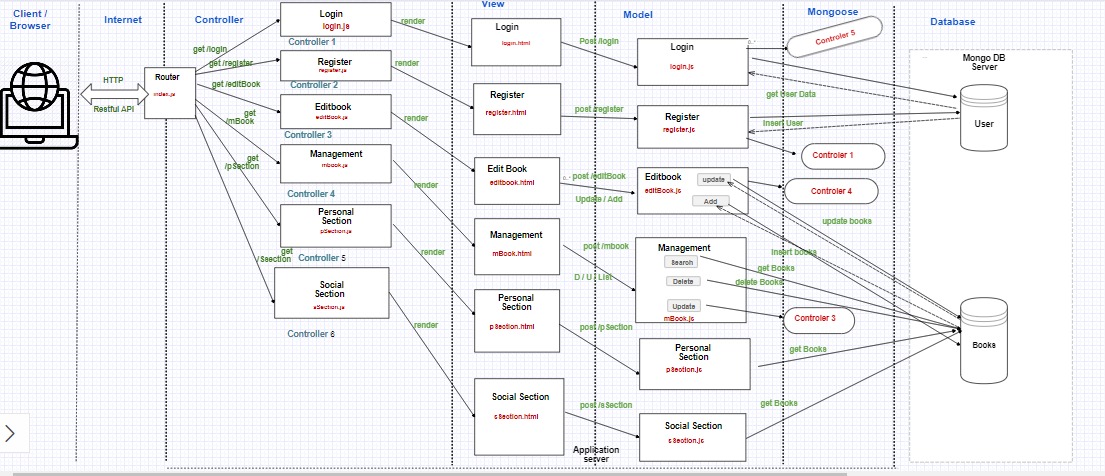


**Figure 1: Social Library Use Case Diagram**

**Web App Architecture**

Figure 2 shows the application architecture and depicts that we have used Model View Controller (MVC) framework to separate our application into three logical components. Model, View and Controller indicate data, user-interface and request-response handler part respectively. The *Model* part shows our data model of MongoDB, the constraints and the format with which we store the data. For instance, in our case, we store data in JSON format so the *Model* represents this in addition to the collections that we have such as user and book. View, on the other hand, uses *Model* and presents data to the user in a form that she wants. When a library user makes a request, for example, if she wants to see her social section then *View* would be the part to show the social section page to user. Different views namely management, personal section etc. can be seen in the architectural diagram.

Finally, the user’s requests are controlled using the *Controller* part and then appropriate response is generated that is fed to the library user. The library user will interact with View, thereby, an appropriate request will be generated and handled by controller. For instance, the user makes a request to view personal section, the *controller* will act as a router and direct the request to psection.js file, which will render appropriate view as a response with using model data. With regards to managing HTTP requests and performing CRUD (Create Read Update Delete) operations, the RESTful API is used. Thus, all the library user’s request including adding, searching, updating and deleting the books etc. are managed with it as shown in the figure 2.

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**Figure 2: Architecture of Social Library App**

**Responsive Web Design**

To enhance user experience, we focused on making a responsive web design and based on that, our web app will change its layout depending on device the web app is opened at. To do this, we used Media Query technique that is based on CSS @media rule. The rule is aimed at including a CSS properties block only when particular condition is met, that is, changing the style on the basis of media device. Now our library app, if opened at mobile browser, doesn’t require zooming to make the text readable and the design elements do not require horizontal scrolling. We have tested the responsiveness of our web app design with *Google’s Mobile-Friendly Test* tool [9]. The test revealed that our social library web application is mobile-friendly.

**Fixing MongoDB Security Problem (MongoDB Blackmail)**

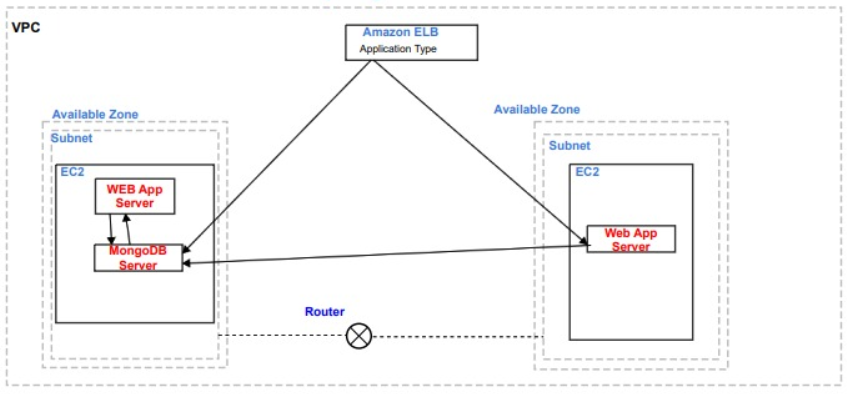
While testing our application, we found that the data from our database has been deleted and it happened three times. The problem was that MongoDB was exposed to public on internet without any security policy and also, it does not have a password by default so hackers can attempt to scan the database and then delete the data for blackmailing the victim. The same happened to us and each time the data was deleted, a .Recovery database instance had been shown to us which provided us recovery email address that was unknown for us.

To solve the problem, we closed the port 3000 and 27017 by using AWS security group function. Now MongoDB cannot be accessed from internet, but can only be used by webserver in subnet. We have set inbound rules and opened the ports 80, 22, and 443 for HTTP, SSH, and Custom TCP Rule traffic types respectively. Port 80 and 443 will allow inbound HTTP access from all IPv4 and IPV6 addresses respectively while port 22 will allow inbound SSH access to Linux instances from IPv4 IP addresses in our network

**Jenkins**

**Application Deployment**

After developing the application, it is not like we keep our computer running 24/7, therefore, we have hosted our service on a remote environment, that is, Amazon Web Services (AWS). AWS [10] aims at providing cloud computing platforms as well as APIs, on demand and metered pay as you go basis. Our online library application can now be accessed by any user of the app at any time. With AWS, we have stored and served our client side files (S3), a virtual server that can be kept on for as long as we need (EC2), and a cloud database management system (RDS). Using [REST](https://en.wikipedia.org/wiki/Representational_State_Transfer) architectural style, offerings of AWS are accessed over HTTP.



To make our application highly available, scalable, and elastic, we needed to have a high level administration mechanism for coordination between backup and front-line instances. Having a running replica of an instance that has failed recently will not help because the visitors of our library app would not know where to go and find it. For this, we have added a load balancer to the mix for monitoring health of running instances. In this way, if one instance goes dark, load balancer will automatically redirect incoming traffic towards active resources. We have used Amazon’s Elastic Load Balancing (ELB) as a load balancing tool and it will not only manage failovers but also focus on balancing traffic loads amongst multiple resources for satisfying defined performance and efficiency needs. After configuring the load balancer with addresses of all of our servers, its own network address is now the only URL that our users need to access. The users do not need to know the individual IP addresses of each of our servers.

Although the sudden loss of a server can be accommodated gracefully by the load balancers, they cannot replace the lost capacity originally provided by now-dead server. In other words, if one out of our three server crashes, the full workload will have to be managed by the remaining servers on their own. Load balancer cannot help us out in this area as it is well beyond its pay scale. And regarding elasticity, load balancer keeps what we have got running nicely, but they are unable to manage change. Furthermore, as we are concerned that increased demand or unexpected server downtime may unable our application to do its job properly, therefore, we found a way of adding capacity using auto scaling. With auto scaling, we have automated instance replacement in case of failure. Moreover, depending on the need, the number of running instances can now be increased or decreased.

**References**

[1] <https://jquery.com/>

[2] <https://getbootstrap.com/>

[3] <https://nodejs.org/en/>

[4] Mardan, Azat. (2018). Full Stack JavaScript: Learn Backbone.js, Node.js, and MongoDB. 10.1007/978-1-4842-3718-2.

[5] <https://expressjs.com/>

[6] <https://www.mongodb.com/>

[7] <https://www.jetbrains.com/idea/>

[8] <https://nosqlbooster.com/>

[9]<https://search.google.com/test/mobilefriendly?utm_source=mft&utm_medium=redirect&utm_campaign=mft-redirect>

[10] <https://aws.amazon.com/>