

# **StudyBuddy**

## **A Web Application for Collaborative Reading**

CSC 554 - Human Computer Interaction

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## Introduction

“StudyBuddy” is a web application designed to facilitate collaborative reading in the group study environment. The application incorporates functionalities to allow users to form study groups and perform reading activities in a coordinated manner. Multiple users can read a document simultaneously, adding annotations to the document as and when they are reading it. They can also choose to view annotations added by other group members and get updates about the same in real time.

Group studying is a practice which is widely used but there has been very little research in the area of facilitating digital group reading activities. Our goal is to come up with an application that provides users easy way to read and discuss study material collaboratively on a digital platform.

This document describes the problem domain for this application and the process of discovery, design, development, evaluation and analysis that we went through in order to make this application.

## Task Domain

The system is a collaborative reading application. It is aimed at helping students who are required to read a paper or some similar material as a group.

Currently the focus of the application is : academics. The application can be extended to a larger domain that includes more types of users like book clubs including readers reading for leisure and so on.

Here, the user can perform activities like joining a group, creating a new group, uploading documents to a group and leaving a group.

## Stakeholder Identification

Primary stakeholders: Students using the application

Secondary stakeholders: Students who create public groups and upload documents to the application that can be used by other users.

Facilitators: Us as the designers and developers of the application.

## Related work

Currently there does not exist any application that supports collaborative reading. The StudyBuddy application draws on applications like [Google Docs](#)<sup>1</sup> which provides editing of a document as a group, [Adobe Reader](#)<sup>2</sup> which is a tool which facilitates adding annotations to a document offline and [Facebook](#)<sup>3</sup> which provides capabilities of creating groups, searching for groups, loading documents to groups, etc.

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<sup>1</sup> "Google Docs - create and edit documents online, for free." 2014. 26 Nov. 2015

<<https://www.google.com/docs/about/>>

<sup>2</sup> "Adobe Acrobat Reader DC Download | Free PDF viewer for ..." 2009. 26 Nov. 2015

<<https://get.adobe.com/reader/>>

<sup>3</sup> <<http://en.wikipedia.org/wiki/Facebook>>

## Design Considerations

Since our application focused on collaborative reading, we decided to build a **web application** instead of going for mobile platform. We wished to build a reader interface that can be used by the user to open and read documents as well as add annotations and view other's annotations. After inspecting other digital reading applications available for desktops and mobile devices, we concluded that such a reader can be best viewed on a desktop web-browser. A mobile application would have restricted the reader interface to a mobile screen, and that would not have been conducive for functionalities like viewing comments, highlights and other annotations.

### Navigation and Layout

Our focus was to create an application where it is easy for the user to navigate between different pages. We decided to have a Tab layout for our application wherein a logged in user will always be shown option to view his groups and documents by having 'My Groups' and 'My Documents' in the left panel. Later on, we introduced 'Create Group' button here as well, since we observed that many users spent a lot of time locating this button when asked to perform Create Group task. Also we decided to have a common header for all the pages after the user has logged in. This header gives user options to perform tasks such as searching for groups/documents, view notifications, view profile and sign out. Hence all the pages which are loaded after user has logged in, are displayed with a left panel and top header. Such kind of layout was chosen by taking into consideration "**visibility**" and "**consistency**" principles<sup>4</sup>, which makes it easier for the user to navigate within the application, enabling him to access important "global" functionalities from anywhere in the application.

### Reader Screen

Since digital collaborative reading is an uncommon domain, we decided to refer to a number of applications designed specifically for reading. The functionalities that need to be incorporated in the reader are similar to the collaborative reading application described in : Co-Reading: Investigating Collaborative Group Reading<sup>5</sup>. Some features that can be seen in the reader design are as follows:

- **Toolbar for easy access:** After referring to various document readers like Adobe Reader, we decided to have a toolbar which is placed on top of the reader screen which would allow user to perform activities such as Print, Email, Page up/down, Zoom in/out, Search for text, Selection, Adding annotations etc. Having a toolbar visible at the top makes it easier to navigate between the pages.
- **Easily recognizable icons:** Common icons were chosen instead of text to represent the functions on the toolbar since they make more appealing visual interface when there are lot of functions to choose from, especially for expert users. We made sure that the user knows which icon refers to which function by displaying a descriptive

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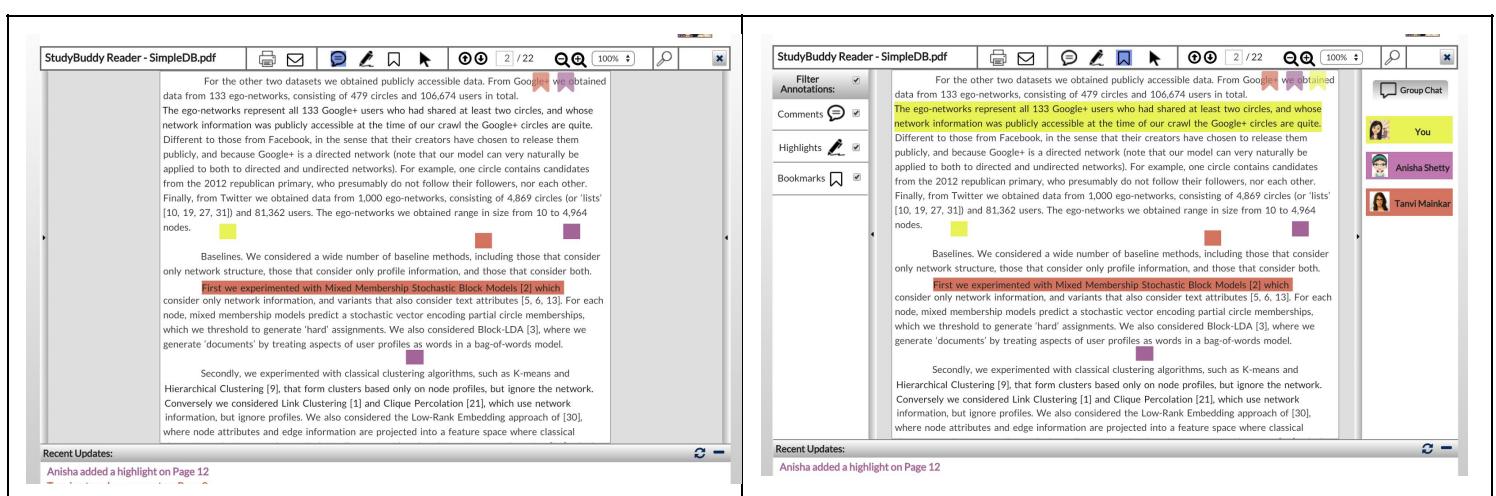
<sup>4</sup> Preece, Jenny, Helen Sharp, and Yvonne Rogers. *Interaction Design-beyond human-computer interaction*. John Wiley & Sons, 2015.

<sup>5</sup> Pearson, J. "Co-reading: investigating collaborative group reading - ACM ..." 2012.  
<<http://dl.acm.org/citation.cfm?id=2232876>>

text when icon is hovered. These icons were tested during the evaluation of the low fidelity prototypes.

- **Side panels for ease of collaboration:** Left and right side of the screen is used to incorporate collaboration. On the right panel, all group members who are a part of the group are shown. User can choose to enable/disable their annotations by simply selecting/deselecting them. All other users' annotations are disabled by default. The users and their annotations are color coded. That means each user is displayed in the right panel with a distinct background color. Same color is used to display his annotations so that user can easily map annotations with their owner. These decisions were taken based on the initial round of interviews in the discovery process. On the left side panel, we are providing user the ability to filter annotations so that he can choose to view only highlights or only comments etc. Checkboxes are used to allow easier filtering.
- **User control:** The functionality of selecting/deselecting the users to view annotations and filtering annotations by comments, highlights or bookmarks, was provided to give the user more control over what he wants to view. The left and right panel are made collapsible so that user can close them anytime and focus just on the reading text.
- **Real-time updates:** The bottom area of the screen is designated for displaying real time updates of other users' activities like any annotation added by another user somewhere on the document.

We decided to have three types of annotations - comments, highlight and bookmarks. In physical reading setup, commenting and highlighting is a common way of emphasizing text and making notes for future reference. Bookmarking is a common way to add a placeholder in physical books<sup>6</sup> which we decided to simulate in our application as well. We also emphasized on making it easy for the user to remove annotations that he doesn't want. Hence comments are provided with a 'delete' button, highlights are shown with 'remove highlight' button. Bookmarks can be disabled by a simple click. The reader interface we designed looks as given below:



<sup>6</sup> Pearson, Jennifer, George Buchanan, and Harold Thimbleby. "HCI design principles for ereaders." *Proceedings of the third workshop on Research advances in large digital book repositories and complementary media* 26 Oct. 2010: 15-24.

## Discovery

The discovery phase of the application was performed to identify different components of the application and requirement gathering. We performed a set of activities to collect the information from a group of users and based on our interaction with them, we came up with series of workflows that our application would contain.

## Collection

We decided to go through collection process by using Elicitation<sup>7</sup> and Observation methods.

Elicitation (Interviews): Since our application is based on collaborative reading, it was easy for us to find fellow students (potential users) who are frequently involved in group study activities. Our team came up with a mix of open-ended and close-ended [questions](#) to ask these users in order to identify their expectations and requirements from the system. We selected three users for this interview. We provided them with a brief background about our application and proceeded with the questions. The questions and notes taken during the interviews can be viewed in the [appendix](#).

We realized that most of our target users prefer online reading rather than reading a physical book. While studying in a group, usual problems faced by them were coping up with different speeds and understandings of their team members, resolving queries of each other which breaks their flow and most importantly, after the meeting keeping track of different points that were made during their discussion.

Observation: We also implemented observation technique to gain insights about how students usually behave while working in a group. We attended two group meetings where students were working in collaboration. First group was a study group formed by students who were reading material for their upcoming exam. Other group, as part of their course work, was required to read a research paper in groups of three and summarize it in form of a report. We observed that the general problem faced by these students was communicating with each other what parts of text they think important. They had to keep referring to particular text on a particular page which they found significant and then other team members would look it up and provide their opinions. Sometimes, they had to go back and forth to search for a text that they had found of importance. This made us take the decision on what kinds of annotations we require in our application and providing ability to effectively communicate with other team members.

## Interpretation

The collection process gave us a good deal of information about what kind of set-ups students study in, their general problems and their expectations from a collaborative reading application. After analyzing all the interview answers and observation notes, we came up with below set of **tasks** that the user can perform:

User should be able to:

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<sup>7</sup> Hom, J. "The Usability Methods Toolbox Handbook - TU/e." 2015.

<<http://www.idemployee.id.tue.nl/g.w.m.rauterberg/lecturenotes/usabilitymethodstoolboxhandbook.pdf>>

1. Log in or sign up in the application.
2. Search for groups that he wishes to join.
3. Join a group.
4. View list of groups that he is a part of.
5. View information about a particular group. View documents associated with it.
6. Share documents with other group members.
7. Create a new group. Invite people to join this group.
8. Read documents and add annotations to it. Annotations would include highlighting, comments and bookmarks.
9. View annotations added by other group members.
10. Able to communicate with other group members.
11. Get updated when another user adds an annotation.
12. Exit a group.

Based on these tasks, we determined series of actions that a user can perform when using this application. We created [flowcharts](#) to represent these generic workflows, which can be viewed in the appendix.

## Design and Implementation

The process followed was an iterative process<sup>8</sup> which included user feedback after each iteration. The design was updated based on the user feedback and observations made by developers during user testing.

### First Iteration

The first iteration of the design process consisted of the following steps:

1. Create scenarios based on the results of the task analysis
2. Create low-fidelity prototypes of the system
3. Evaluation of low fidelity prototypes

Once the goals were identified by the task-analysis step, scenarios<sup>9</sup> were created to encompass the main functionalities of the system. The detailed scenarios are available in the appendix. These scenarios were used to build and test the low fidelity prototypes.

The low-fidelity prototypes<sup>10</sup> were created based on the scenarios above. We set a deadline for the creation of prototypes corresponding to each goal so that we do not spend too much time on a single prototyping activity. The low fidelity paper prototypes have been added in the appendix.

<sup>8</sup> "Designing for Usability - Ee Oulu Fi." 2012.

<<http://www.ee.oulu.fi/~vassilis/courses/pui09S/papers/gould-85.pdf>>

<sup>9</sup> "Scenario based design | Mary Beth Rosson - Academia.edu." 2013. 26 Nov. 2015

<[http://www.academia.edu/2824645/Scenario\\_based\\_design](http://www.academia.edu/2824645/Scenario_based_design)>

<sup>10</sup> "Prototyping for Tiny Fingers - Ace Recommendation Platform." 2013. 26 Nov. 2015

<<http://www.learningace.com/doc/5557579/871428baf77d69f3c3661663808404ba/prototyping-for-tiny-fingers>>

Next, we identified a set of representative users who would test our prototypes. We selected students who were currently enrolled in courses that required them to read some material as a group. The users were given a scenario and were observed as they performed the tasks described by the scenario. At the end of each scenario, they were asked to rate their experience. Every task in the scenario was rated on a SEQ<sup>11</sup> scale of 1 to 7, 7 being the easiest and 1 being the most difficult. Additionally observations were made by us, the developers as the user performed each task. The tasks that the users seem to struggle with were noted down. This testing was performed for 5 such users. The scenarios and the task ratings are available in the [appendix](#).

## Second Iteration

The second iteration consisted of the below steps:

1. Analysis of feedback after testing the low-fidelity prototypes
2. Brainstorm to list changes to incorporate
3. Create high fidelity prototype with updated design consideration
4. User testing

The tasks were arranged and those which were rated on the difficult end of the scale were given a higher priority. Each such screen was analysed and modifications were made to them. The complete list of changes are available in the [appendix](#).

Some of the major decisions made in this iteration are mentioned below:

Modification: Use of username to login to the application

Alternatives considered:

1. use email id to login to the application
2. Use a separate username specially for this application

Based on the feedback received from users when they were asked to Login to the application, we found out that remembering the username added a cognitive load on the user. We observed that 2 out of the 5 users struggled to remember their usernames that they had entered.

Design decision: In order to decrease the memory load on the user, we updated the signup and login pages in a way that the users only have to enter their email address to signup and login.

Modification : Uploading more than one documents

Alternatives considered:

1. Create group window contains an upload document link
2. Avoid redirection to a new window for upload . Instead implement a popup window to upload a document

When the users created a group, there were 3 instances where the users seemed thrown off due to the navigation to a new screen for upload.

Design decision:

The users should be aware of the context they are working in. For this principle to hold, it is necessary that the users know that they are in the Create group stage as they are uploading

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<sup>11</sup> "SEQ - Measuring Usability." 2014. 26 Nov. 2015 <<http://www.measuringu.com/blog/seq10.php>>

the document. Thus the upload document is now implemented as a pop-up which appears within the Create Group page.

Modification: Placement of Group chat in the Reader page

Alternatives considered:

1. The group chat's current position i.e. superimposed on the text ([Prototype #11](#))
2. On the right corner of the screen

Design decision:

The users should be able to view the reader's data while using the group chat. Thus adhering to the design principle of visibility, we decided to place the group chat on the right corner of the screen

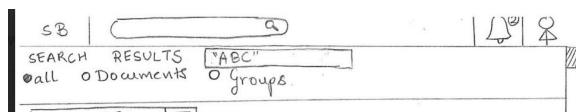
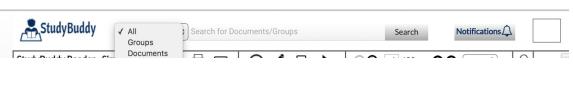
Modification: Improvement of the search toolbar

Alternatives considered:

1. Provide a radio button after search result is displayed so user can choose filter
2. A single search bar with the filter that the user may wish to apply

Design decision:

The User should have freedom to choose what filters he/she may want to apply before searching. Also the user should be able to control the results even after they are displayed. Thus we decided to incorporate the filter in the search bar so that the user can have the freedom to apply the filter whenever he /she wants

Before	After
	

The high-fidelity prototype was created using bubble.is<sup>12</sup>. Bubble is a visual programming language which allows you to create and design powerful applications .

Once the high fidelity prototype was created, the users were asked to perform a set of tasks similar to the previous iteration. The tasks that were used in this iteration of usability testing were same as listed in the [interpretation](#) section. Again 5 users were asked to perform these tasks. Observations were made as they performed these tasks. Additionally, user feedback was taken and documented.

### Third iteration

The third iteration consisted of the below steps:

1. Analysis of feedback from iteration 2
2. Brainstorm to list changes to incorporate in iteration 3
3. Update design as per feedback

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<sup>12</sup> "Bubble - Visual Programming." 2014. 26 Nov. 2015 <<https://bubble.is/>>

The tasks were arranged and those which were rated on the difficult end of the scale were given a higher priority. Each such screen was analysed and modifications were made to them. The complete list of changes are available in the [appendix](#)

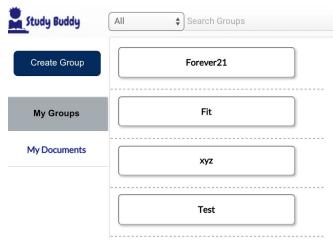
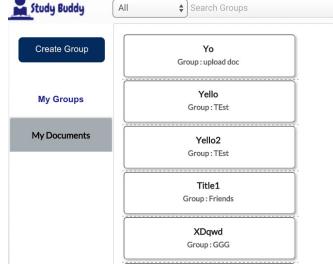
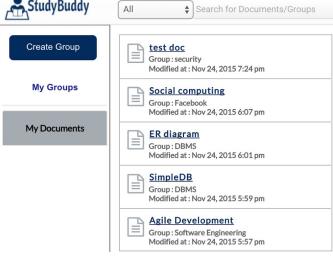
Some of the major decisions made in this iteration:

Modification: Look of Groups and Document buttons

Alternatives considered:

1. Similar looking buttons for groups and documents. Since they appear in different tabs, they may have a similar look
2. Add icons to differentiate between Groups and documents

The final design follows the techniques of visual design like representation (icons help users associate the type of object with its functionality), association by unity (the list is arranged in such a way that objects of one kind are grouped together) described in Visual Techniques for Traditional and Multimedia Layout.<sup>13</sup>

Before	After
	
	

Modification: Addition of update box in the reader

When real time updates(annotations added by other users) appeared on the reader, we found that users needed additional cues to get an idea about the order in which the annotations were added.

Thus we decided to add an update box which notifies about the most recent annotations added by other users. This adheres to the principle of continuous and visible feedback. It reduces the cognitive load on the user. Even if she/he misses an update, she/he can refer to the update box and view the most recent updates made,

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<sup>13</sup> Vanderdonckt, J. "Visual techniques for traditional and multimedia layouts." 1994.  
<http://dl.acm.org/citation.cfm?id=192334>



Fig. Recent Updates dialog box

## Walkthrough

Once all the changes were incorporated into our design after getting user feedback from all the design iterations, our final application interface was completed. We use this application interface to provide a written walkthrough of the representative tasks that a user may perform using our application as given below:

### 1. Login/Sign-up

The login screen for the StudyBuddy application. It features a logo at the top left. Below it are two input fields: 'Email Id' and 'Password', both with placeholder text. A 'Forgot password?' link is located below the password field. At the bottom is a dark blue 'LOG IN' button. Below the button is a yellow link: 'Don't have an account? [SignUp >>](#)'.

Fig. 1 Login Screen

The sign-up screen for the StudyBuddy application. It has a logo at the top left. On the right is a placeholder image for a profile picture with the text 'Click on image to upload'. Below the logo are four input fields: 'First Name\*', 'Last Name\*', 'Email Id\*', and 'Password\*'. Underneath these is a 'Confirm Password\*' field. At the bottom are two buttons: a dark blue 'SIGN UP' button on the left and a light blue 'CANCEL' button on the right.

Fig. 2 Sign-up Screen

The first screen is the login screen the user lands on. Here, if the user is already a member, he/she can login by entering the credentials - Email ID and Password. If not a member, the user can click on the sign-up link given below which will take him/her to the sign-up page, where after adding the details the user can sign-up into the system. Once signed-up, the user will go to the home-screen of the application as shown below.

## 2. Home screen and Creating a Group

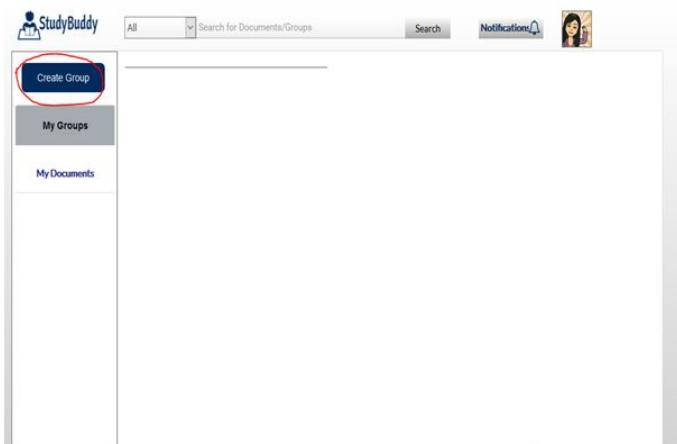


Fig. 3 Home Screen

Fig. 4 Create group – Add members

After signing-up, the home screen will appear as shown in Fig. 3. The home screen layout consists of two tabs on the left, one to view all the groups the user is a part of, and second to view all the documents the user has access to. Since the user is not a part of any group right after he/she signs up, the My Groups section is empty. Also, on top you can see a header that consists of the StudyBuddy Logo, a search bar, a notifications button, and the profile picture of the current user. This layout appears consistently throughout all the screens of the application so that the user can have easy access to these options.

The user can create his/her own group by clicking on the “Create Group” button shown in Fig. 3. In Fig. 4, you can see the Create Group form where the user has entered group details and is seen adding members to the group.

## 3. Uploading a document

Fig. 5 Create group – upload documents

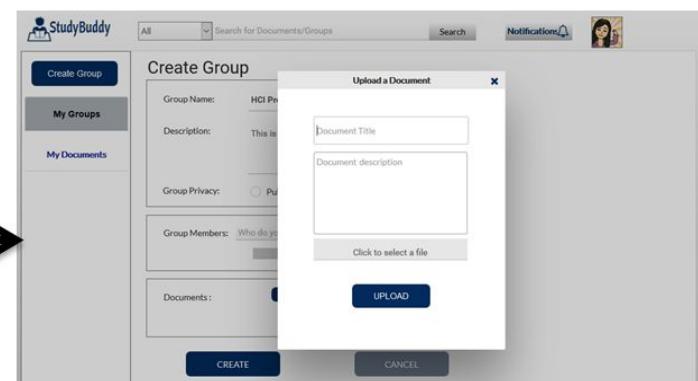


Fig. 6 Upload documents pop-up

The user can upload documents while creating a group by clicking on the “Upload Documents” button as shown in Fig. 5. A pop-up will appear where the user can add details such as Document Title, Document description and select a file from his/her local machine to be uploaded to the group.

#### 4. Group created and Document uploaded

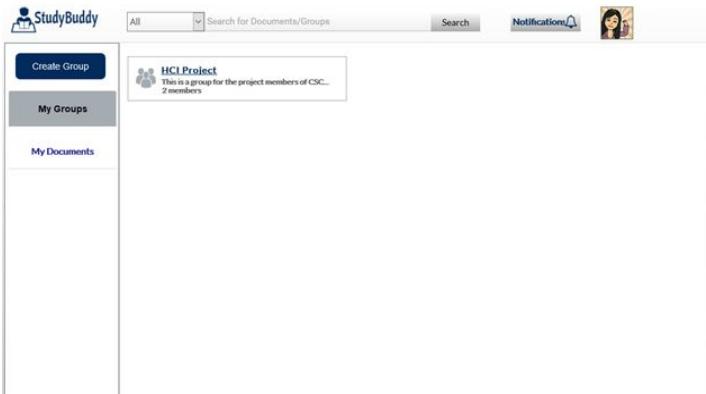


Fig. 7 My Groups – shows just created group

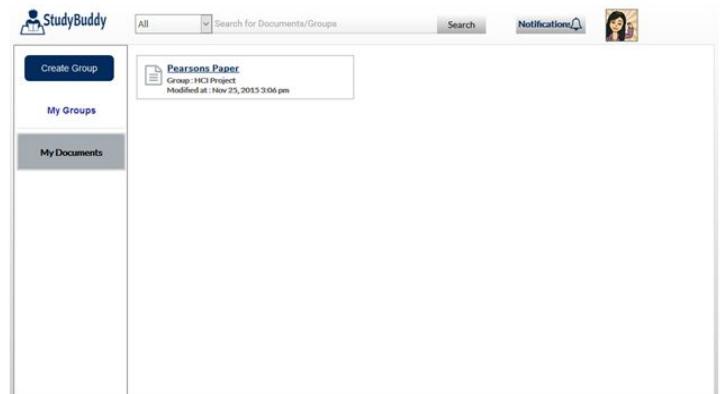


Fig. 8 My Documents – shows just uploaded document

Once the user clicks on “Create” button, he/she will be redirected back to the home screen as shown in Fig. 7 and his/her My Groups tab will be populated with the group he/she just created. Also, going to the My Documents tab will show the document that was just uploaded by the user.

#### 5. Searching for groups that include “HCI” in their group names

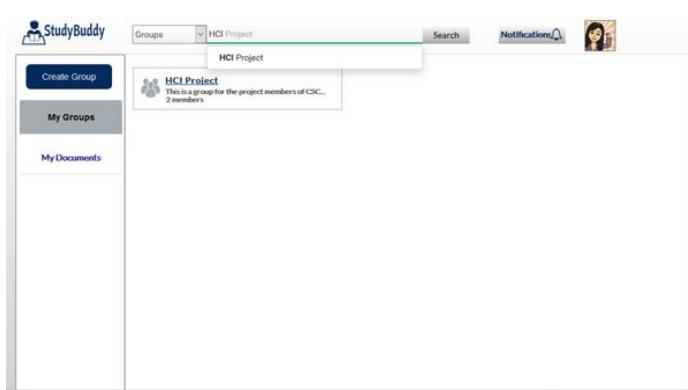


Fig. 9 Searching Groups



Fig. 10 Search results

The user can search by groups only, by documents only, or by both using the filter given next to the search bar. Suppose the user wants to search for groups that are related to HCI, he/she will select Groups from the dropdown, then type HCI in the search bar and click on “Search” button. The search results will be displayed as shown in Fig. 10. Here you can see that all groups that include the string “HCI” in their name are listed. If “Joined” button shows that the user is already a part of that group.

## 6. Joining a group



Fig. 11 Send join request

Fig. 12 Cancel join request

If the user wishes to join any of the groups listed in Fig. 10, he/she can click on the “Join” button next to the group name and a join request will be sent to the moderator of that group. The button will change to “Join request sent” to notify the user of the action as shown in Fig. 11. If the user wishes to cancel a join request, he/she can click on the same button again, and the option to cancel the request will be provided to him/her as shown in Fig. 12.

## 7. Viewing a group home page from My Groups



Fig. 13 Open a group from My Groups

Fig. 14 Group home page

Suppose the user wishes to view details of any of his/her group, he/she can go to the My Groups tab and click on the group the user wishes to open. The My Groups tab consists of a list of all the groups the user is a part of and displays other details like the group description and number of members along with the group name. In Fig. 13, the user is clicking on the Software Security Group. On clicking the group name, the group home page opens which is shown in Fig. 14. The group home page displays the Group Name, Group description, the documents that are currently being read by the group, the members present in the group, creator of the group, as well as a link to the discussion board. Also, an option to upload documents in the group is available. Suppose the user wants to open a particular document, he/she can do so by clicking on the document name given here, as shown in Fig. 14, or through the My Documents tab shown in Fig. 8.

## 8. Opening a document in Reader

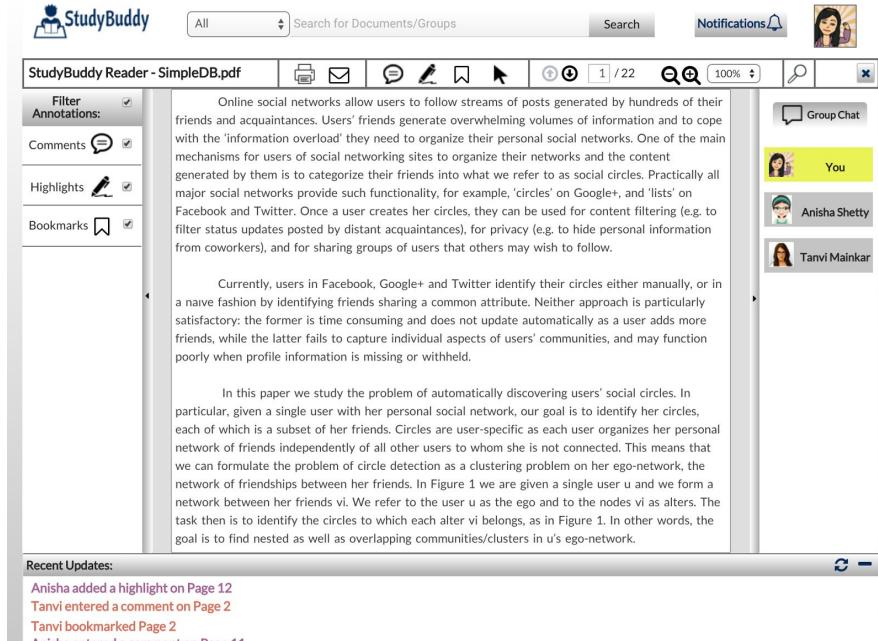


Fig. 15 StudyBuddy Reader

Once the user clicks on the document, it opens in the StudyBuddy Reader. The reader looks like shown in Fig. 15. The various components present on the reader are explained in the “Design Considerations” section given above. By default, all the users are deselected so you do not view their annotations at first.

## 9. Adding a comment

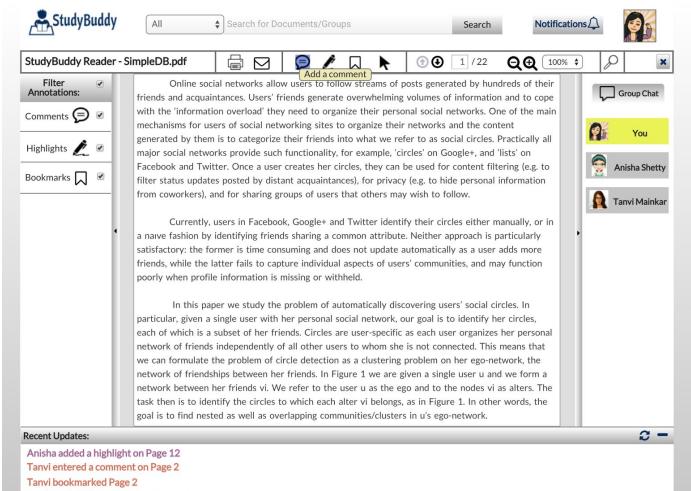


Fig. 16 Selecting “Add a comment” tool

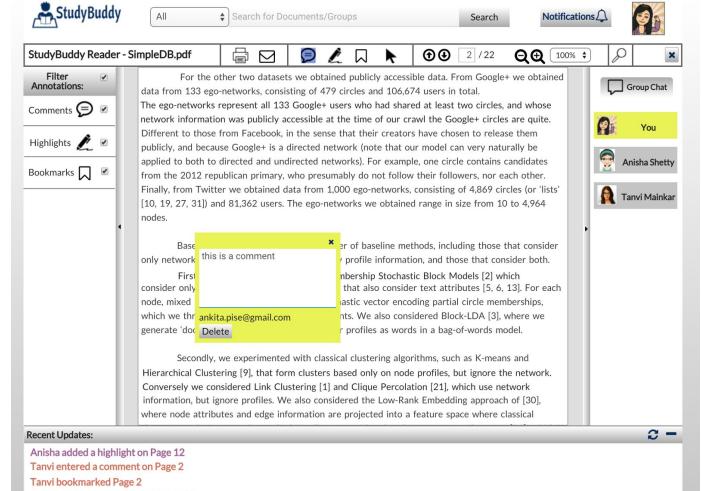


Fig. 17 Adding a comment

The user can add a comment by clicking on the comment icon given in the toolbar. After clicking, the tool gets selected, and the user can take the cursor and click on the page where he/she want to add a comment. A comment box appears as shown in Fig. 17, where the user can type the comment, or delete the comment as well. On closing the comment box, a small square icon appears where the user has added a comment, which is of the color that corresponds to the user. This can be seen in Fig. 18 below.

## 10. Adding a highlight

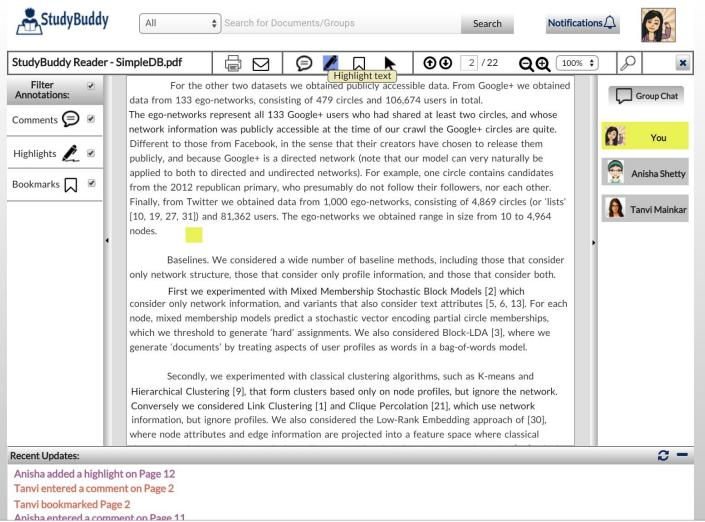


Fig. 18 Selecting “Highlighter” tool

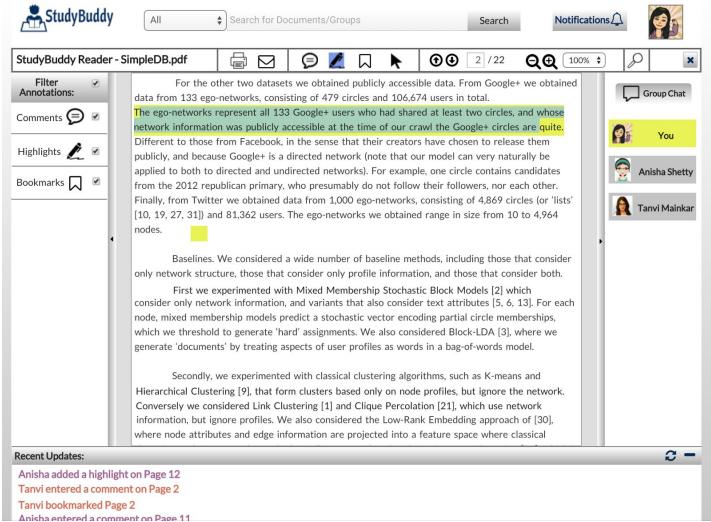


Fig. 19 Adding a highlight

If the user wishes to add a highlight on the document page, he/she can click on the highlighter icon present in the toolbar. The highlighter tool will be selected and then the user can select the text on the page that he/she wishes to highlight. The selected text will be highlighted by the color corresponding to the user.

## 11. Adding a bookmark to a page

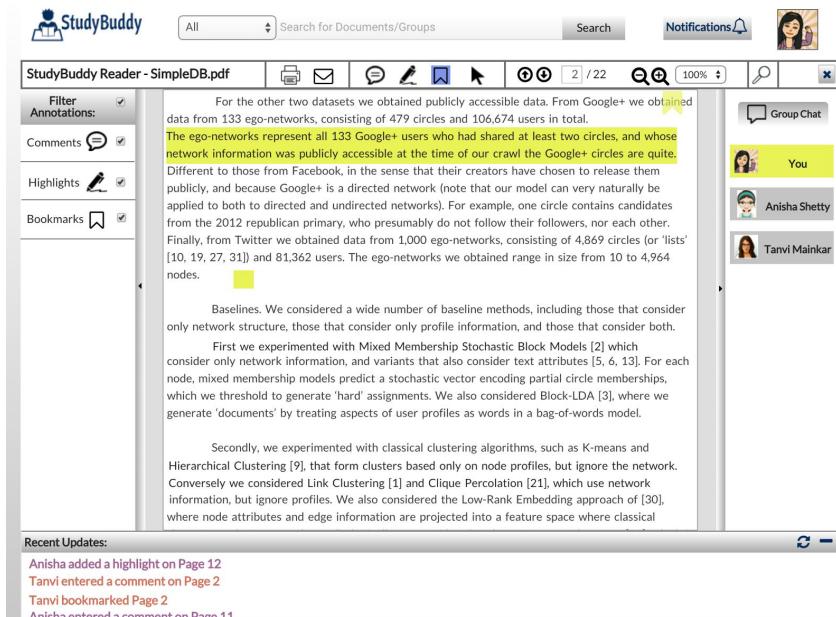


Fig. 20 Adding a bookmark

If the user wishes to add a bookmark to the current page he/she is reading, he/she can click on the bookmark icon in the toolbar. A bookmark of the corresponding color will appear in the upper right corner as shown in Fig. 20. To unbookmark the page, the user needs to click on the bookmark icon again.

## 12. Viewing annotations of other users

This screenshot shows the StudyBuddy Reader interface for a PDF document titled 'SimpleDB.pdf'. The sidebar on the left includes filters for 'Annotations' (checked), 'Comments' (unchecked), 'Highlights' (unchecked), and 'Bookmarks' (unchecked). The main content area displays text with annotations from three users: 'You' (yellow), 'Anisha Shetty' (purple), and 'Tanvi Mainkar' (red). A red box highlights the annotations from 'Tanvi Mainkar'.

Fig. 21 View other's annotations

This screenshot shows the same PDF document as Fig. 21. A red box highlights a comment from 'tanminka@ncsu.edu' in the text area. A larger red box highlights the entire comment section, and a smaller red box highlights the email address 'tanminka@ncsu.edu'.

Fig. 22 View comment of other user

To view annotations by other users, click on the user you wish to view the annotations of. Once the user is selected, the corresponding color appears so you know which annotation belongs to which user. In Fig. 21, you can view the annotations of all the selected users. the user can click on the comment square to view the comment of the user, as shown in Fig. 22.

## 13. Filtering annotations and Group Chat

This screenshot shows the StudyBuddy Reader interface with the 'Highlights' filter checked in the sidebar. Only the annotations from 'Anisha Shetty' (purple) and 'Tanvi Mainkar' (red) are visible. A red box highlights the purple annotations from 'Anisha Shetty'.

Fig.23 Filtering annotations to view highlights only

This screenshot shows the StudyBuddy Reader interface with a 'Group Chat' window open. The window displays a message history between 'You', 'Anisha Shetty', and 'Tanvi Mainkar'. A red box highlights the message 'Hello' from 'You'.

Fig. 24 Group Chat Pop-up

Other features include filtering annotations using the filters given in the left sidebar. In Fig. 23, you can see that the user has applied the highlights filter, hence only the highlights can be seen. Also, user "Anisha Shetty" has been deselected so you cannot view her annotations. Also, a group chat option is given where the user of the group can chat while online, as shown in Fig. 24.

## 14. Leaving a group

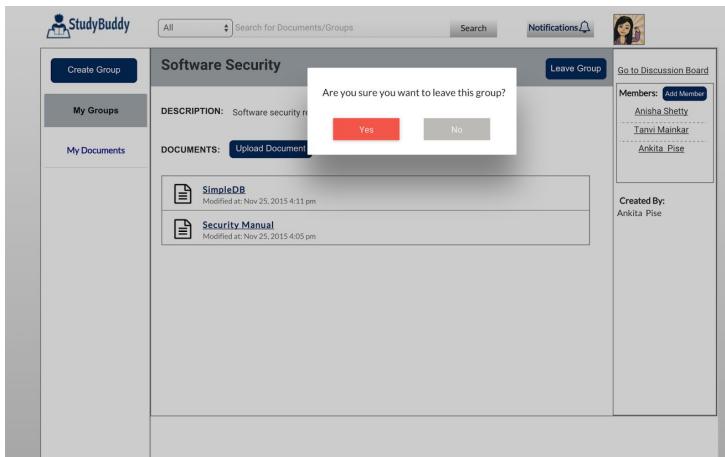


Fig. 25 Leave group confirmation

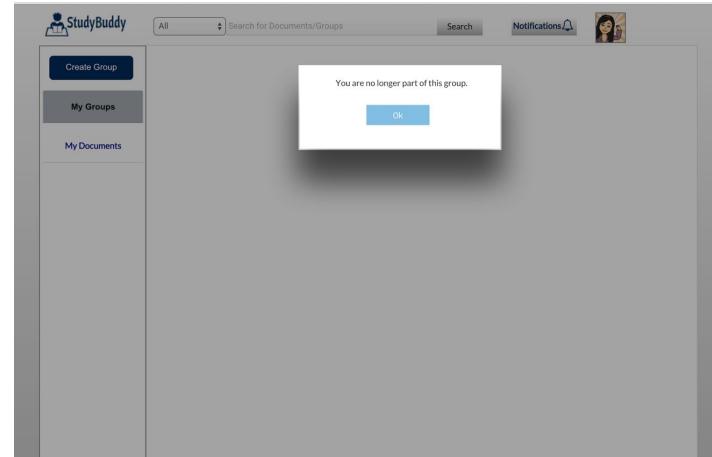


Fig. 26 No longer part of the group

If the user wishes to leave a group, he/she has to click on the Leave Group button on the group home page shown in Fig. 14. The user will get a confirmation asking if he/she is sure. Once the user selects yes, he/she is removed from the group.

## 15. Discussion board and Notifications

The screenshot shows the discussion board for the 'Software Security' group. It lists topics such as 'Group assignment\_3', 'Teammate Search for project\_2', 'Query about Fitt's Law', and 'Reading before Lecture 10', each with author, replies, and last post details. A link 'Add a new Post' is visible at the top right.

Fig. 27 Group Discussion Board

The screenshot shows the 'Notifications' section. It lists notifications for 'Facebook Project', 'Software Security', and 'CL Project'. It includes messages like 'Anisha Shetty Posted a question on HCI group.', 'Jack Dawson invited you to join CSC-999 QTP group.', and 'Jacob K requested to join HCI group.' A 'See All Notifications' link is at the bottom.

Fig. 28 Notifications

A discussion board is present for every group where the users can post questions or comments they may wish to open a discussion about related to the group and the documents the group is reading. By clicking on the "Go to discussion board" link given on the group home page shown in Fig. 14, the user can view the group's discussion board, which looks as shown in Fig. 27 above. Also, the user can receive and view notifications about the groups and various activities associated with them in the notifications option given, as shown in Fig. 28.

The screencast of a user carrying out major functionalities of the final iteration can be found in the [appendix](#).

## Analytical Evaluation

Analytical evaluation of different functionalities was performed using [CogTools](#)<sup>14</sup>. We simulated different users tasks in this tool and analyzed the time generated. With tasks involving major functionalities (such as Sign up, Create Group, Search, Open Document), think time was included. For ‘Read a document’ task and its subtasks, it was difficult to predict exact location and size of different annotations. Hence for this experiment, we assumed that all comments added by user are located at the center of the page and highlight is made on a single line of the text at the center of the screen.

Task Name	Time taken (in seconds)
Signup	50.21
Login	14.02
Create Group	34.56
Search for a group and join	3.48
Read a document	3.78
a. Add annotations (comments and bookmarks)	10.32
b. View annotations of other users	1.98
c. Filter Annotations	2.45
d. Remove annotation (comments, highlights and bookmarks)	13.76
Chat with a member	5.98
Leave a group	15.32
View Notifications and sign out	3.21

## Formative Evaluation:

The final system was tested again with 5 candidates, who are students of NC State University. Three of them were male and other students were female. Our team of developers was present for each test as Observers. We asked the users to perform same tasks which we had analyzed using [CogTools](#). The resulting average times are measured and displayed in the table. At the end of each experiment, we asked the candidates to rate all task according on SEQ scale. The results are recorded below:

<sup>14</sup> "CogTool | Cognitive Crash Dummies: Predictive human ..." 2008. 26 Nov. 2015 <<http://cogtool.com/>>

<b>Task Name</b>	<b>Time taken (in seconds)</b>	<b>Average Rating(1=extremely difficult 7=extremely easy)</b>
Signup	45	5.75
Login	10.45	7
Create Group	33.08	6.10
Search for a group and join	4.49	6.93
Read a document	3.05 seconds	5.94 ( Average of subtasks)
a. Add annotations (comments, highlights and bookmarks)	8.9	6.22
b. View annotations of other users	2	6.86
c. Filter Annotations	1.87	5.97
d. Remove annotation (comments, highlights and bookmarks)	10.86	5.12
e. Explore toolbar	variable ~ depending on user (This task was introduced just to observe the user)	5.55
Chat with a member	3.08	6.8
Leave a group	11.09	5.87
View Notifications and sign out	1.98	6.13

## Conclusion and Future Work

To summarize, StudyBuddy is a collaborative reading application currently scoped for academic reading activities. The main focus of the application is the reader which allows multiple users to annotate the same material. We found that the users took some time to get used to the functionalities of the reader. We think it is possible that since reading as a collaborative activity was a new concept to all the users , it took some time getting used to the reader. We also found that once the users were used to the reader, they found it quite useful since most of them were involved in academic activities that require them to read/study a common resource.

Users were quite comfortable with other tasks like joining a group, searching for a group and leaving a group. Some of the things which can be improved are the look and feel of Leave Group functionality and Real time updates in the reader. Notifications can be made more specific in future, giving user ability to manage them in-place. Additionally we feel that the reader page should provide the user with some more context regarding his/her location within the application.

Since this was a high fidelity prototype, real-world scenarios like maintaining the state for the user have not been implemented. For example when the user opens a document in the reader, the user should be navigated to the page he/she was at the last time they opened the document.

## Appendix

### Interviews (Collection Phase)

#### Questions:

1. Do you usually partake in group study activities? What activities/materials do you usually prefer studying as a group?
2. When you are collaboratively reading a common piece of literature , how do you go about it? (Do you meet and read at the same time or prefer reading separately?)
3. What are some of the common problems you face?
4. How do you communicate before and after the meeting? (For example: You met with your group and discussed the literature and you realise that there is an important piece of information that wasn't covered during the meet. How would you handle such a situation?)
5. How do you prepare for such a meeting. What are some of the things you do to prepare for such a discussion?
6. What do you do after a meeting? (For example: divide up the content and work on each part individually etc.)
7. What are your views on online reading? What are some of the issues you face when you read some material online as opposed to a physical book?
8. What are your expectations from an ideal online collaborative reading application?

#### Interview 1:

1. Yes I do. Usually it's for a revision session.
2. When I have worked with groups where collaborative reading is necessary, we read the material individually or hook up one of the laptops to the screen . However when we do the latter , we face problems due to different reading speeds.
3. a. Break of flow . Say you are reading in a group and you are currently reading page 4, your teammate has a question regarding the material on page 3. You have to go back which breaks your flow of thought.
  - a. Difficulty in navigation: different reading speeds
  - b. Probability of missing out on points that the other teammate would have caught. Since this point is annotated in the local copy of the teammate, there is a chance of missing it.
4. Send an email/message regarding it. Becomes messy due to numerous instances of back and forth communication
5. Usually try to read the material at least once beforehand. But it so happens that if I forget to make notes, I am likely to miss that information.
6. Divide work if possible
7. Very Comfortable
8. Expectations:
  - a. Add annotations
  - b. See who is online
  - c. Choice to disable all annotations
  - d. Ability to choose the users whose annotations are visible
  - e. Group chat

**Interview 2:**

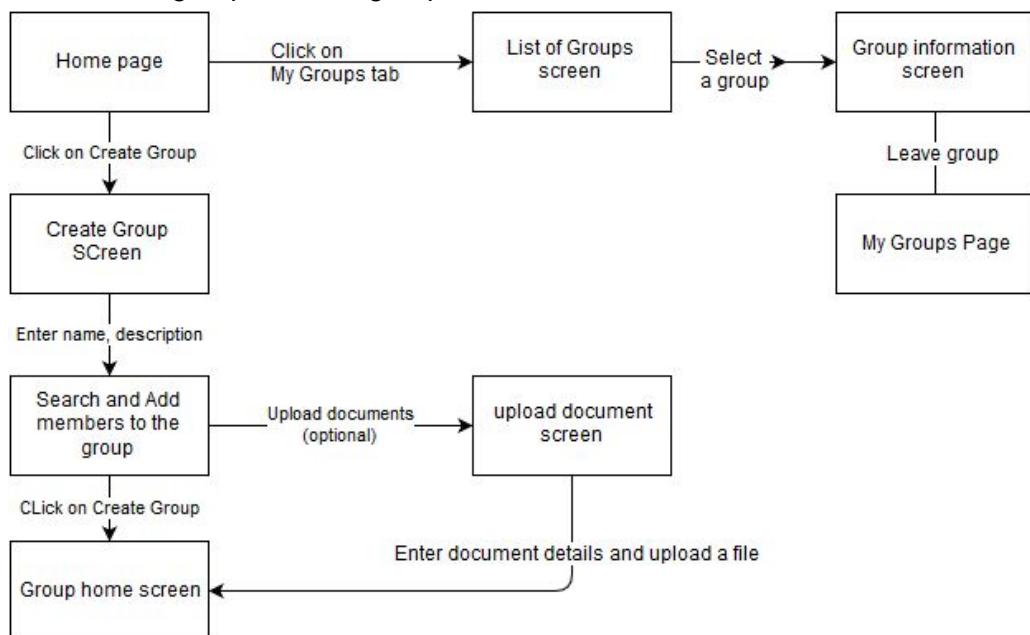
1. Yes
2. Sit together and read individually. when someone has a question, others pitch in to explain the doubt.
3.
  - a. Finding a common time-frame that suits everyone.
  - b. Deciding on a place to meet .
4. Communication is done using [slack](#).
5. Don't prepare anything in advance
6. During the meeting, one of the team members also summarise and take notes of important points. At the end of the meeting , everyone goes through the summary to create a final report.
7. Very comfortable. Prefers online reading more.
8. Expectations:
  - a. Adding annotations
  - b. References. Ability to link a discussion with the relevant part in the reading material by a hyperlink or something similar.

**Interview 3:**

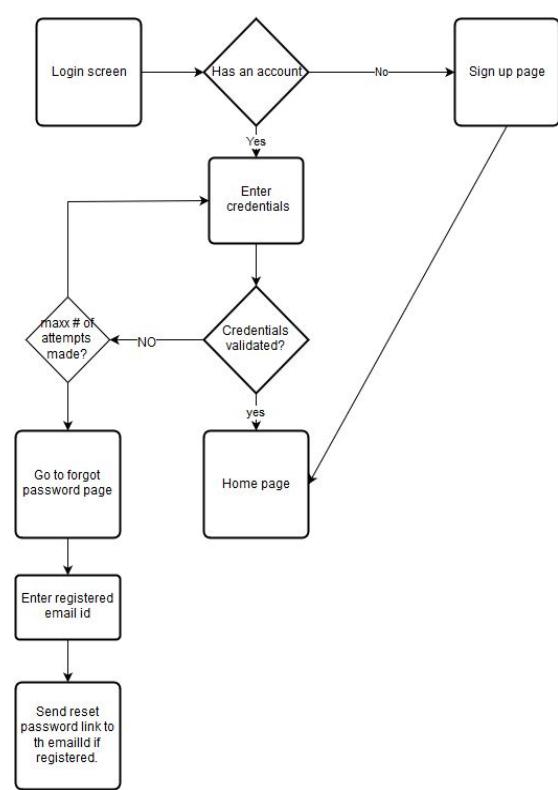
1. Yes. when working on group projects and group assignments.
2. Usually read the same content separately. Later meet and discuss about the paper.
3.
  - a. When meeting the the group, it is sometimes difficult to recollect the important points unless noted down.
  - b. A lot of time is spent in organizing the observations of all the people.
4. Most of the communication is done over emails. Report is usually written in a common document (like Google docs). If anything is missed, one person updates the report and others review it.
5. Try to have a complete understanding of the part that I was reading
6. As said earlier, if anything is missed, one person updates the common document and others review it.
7. Prefers online reading. but not scanned documents-
8.
  - a Should have good performance when multiple users are online
  - b. Ability to differentiate between different users notes
  - c. Should be color coded
  - d. Generate a summary of what others have written

## Flowcharts (Task Analysis)

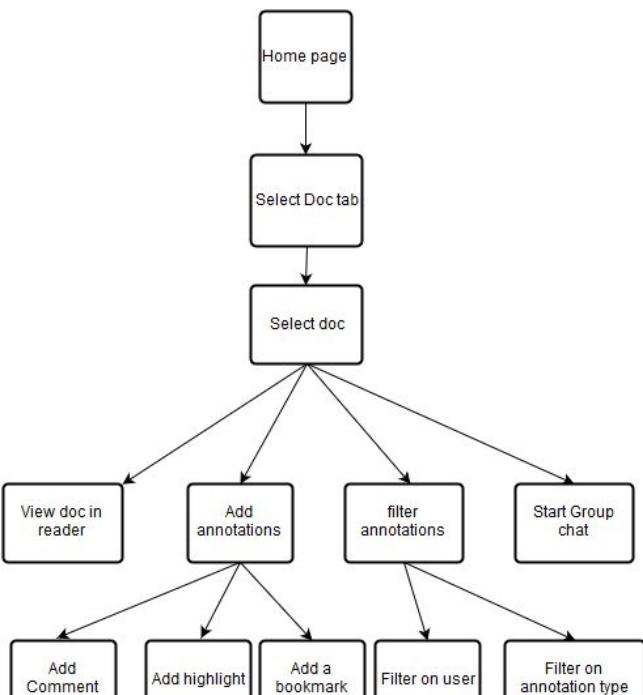
### 1. View group/create a group:



### 2. Login and signup flow:



### 3. Viewing/editing a document:



## Low-fidelity prototypes

1	Home Screen	
2	Sign Up screen	
3	Home Screen : My Groups Tab	
4	Home screen : My Documents Tab	

5	Search result page: All entries (Groups and Documents)		12/18
6	Search result page: View only Groups		12/18
7	Create Group page		12/18
8	Upload Document page		12/18

9	Group page	
10	Reader : Viewing other user's comments	
11	Reader: Viewing group chat	

## Scenarios

1. Felicity is a student at NCSU. She is currently enrolled in the course CSC-591 (Automated Software engineering). This course requires her group (consisting of 2 more students: Alan and Oliver) to read a set of technical papers and write summary for each. Alan tells her about a new web application StudyBuddy they can use for this purpose. Felicity creates an account with StudyBuddy to find out more about the application. Once there she goes ahead and creates a group "CSC-591". She adds Oliver and Alan as members to the group.
2. Oliver logs into his StudyBuddy account and sees that he is now a part of the group: "CSC-591". He views the group's home page and sees that there aren't any documents uploaded. He uploads the paper they were assigned to read. He opens the document within the application and starts reading the paper. He makes annotations like highlights, comments and adds bookmarks as he reads the paper.
3. A few days later, Kate who recently enrolled into the course joins this group. She logs into the application, searches for the group and joins it. When she opens the document uploaded in the group and sees that Felicity, Oliver and Alan have made a number of annotations on the document. She decided that she only wishes to see the highlights made by all of them and hence applies the corresponding filters .

## Tasks and their average SEQ ratings for Low Fidelity Prototypes:

Task	Average Rating over 5 users(SEQ scale 7=extremely easy 1=extremely difficult)
Create Account	6.75
Create Group	4.5
Upload Document	3.5
Search for a group	4.5
Join a group	2.5
Open a document	4
Add annotations on document	5.5
Apply filter on annotations	4

Changes to be incorporated in iteration 2

Sr No	Screen	Change
1	Group home page screen (Member view)	Group size currently below description. Place next to name. make the size a hyperlink when clicked shows the members
2	Group home page	Decrease clutter
3	Home screen	After the user has signed up, he/she would not be a part of any group. In such a case he should be shown proper message
4	Group home screen(member)	needs an upload doc button on the screen
5	Home screen (My groups tab)	add search bar for search my groups
6	Home screen (My Docs tab)	Not enough info about a document
7	Home screen (My groups tab)	clicking on pop-up
8	Upload doc screen	Title need not be same as the doc title mandatory
9	Sign up screen	First name last name (mandatory)
10	Create group screen	description non mandatory, Add cancel button Change button text: invite member → add member
11	Create group screen → upload : feedback of progress missing	Add another screen to show status bar and return to create group to add another doc
12	Create group screen → upload →	Add another doc
13	Header	give separate button to navigate to home?

Changes incorporated in iteration 3

1	Reader → comment	add a comment button in the comment popup. when hovered add a remove comment button (similar to google docs)
2	Group home page	Now viewed on user's home screen and not as a separate page
3	Upload docs	Change ordering of elements on this page. When doc is uploaded, Document title should be extracted automatically
4	Doc views	preview should show title of the doc.
5	Search result Pages	when docs and groups are shown together, group should be below
6	Group join	<ol style="list-style-type: none"> <li>1. after sending request show “request sent”?</li> <li>2. Back to search result button to be added</li> <li>3. Cancel request button</li> </ol>
7	Search bar (header) filter issue	Add a filter on the search bar itself. remove filters on results page instead give a text saying “Showing results for..”

Link to screencast

<https://youtu.be/JLy0BOBPbq0>