

## Introduction

A stroke is a devastating, life-altering, and incapacitating occurrence. The varieties of strokes and the outcomes of having one vary, and most people require a lengthy period of physical and cognitive recovery.

Stroke rehabilitation should begin right soon and frequently entails thousands of repeats of simple tasks. These repetitions are necessary to rewire and retrain the parts of the brain that help mostly psychical movement and improve cognitive abilities. Unfortunately, most stroke survivors do not complete all the exercises advised by their clinicians because they find those exercises boring. As a result, their potential recovery is not met.

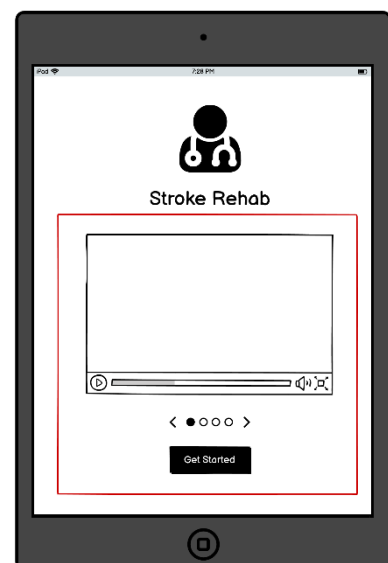
The purpose of this application is to design a mobile application that will help stroke patients to regain above (mostly physical & cognitive) affected abilities. The application is built while focusing on the stroke patients and their carers, where the carers will navigate through the app whenever required and make it ready for patients to exercise. The application has been designed for tablets as the patient might have difficulties seeing a small screen, but it will be available for the small screen sizes(phone) as well. Usability is the key for this application where the main users might not fit enough to understand the functionality of the application. That is why all the usability goals and design principles are being followed while designing. There is two important usability goal that was followed for this application. learnable on first use, where user can watch a tutorial video while start using the app and before each exercise and second, Efficient where user can complete each exercise faster without any difficulties.

Initially, isquio Stroke Rehabilitation app has been taken into consideration while designing the exercise structure (isquio Stroke Rehabilitation, 2015). But as the scope of our application is bigger than isquio, all other functionality has been designed according to the usability goals and design principle and most importantly mobile app design trends and previous design experience.

## Usability Goals and Design Principles

### Learnable on first use:

**Figure 1** represents a good example of Learnable of first use. A user can watch an instruction video when they launch the application and most importantly before starting each exercise. Which will help the user to understand what to expect and how to navigate through the main functionality and complete the exercise. It will help the user what to expect in the future as they are already known that makes the usability of the app easy.



*Figure 1: Instruction Video*

### Memorable on repeat uses:

Figure 2 illustrates a good example of the memorable on repeat uses that has been implemented in designing the application very well. Users can know what each icon represents and take necessary action whenever required. For example, in above Figure 2, Trash can represent deletion, and the camera icon represents capturing images. These icons are globally used and recognizable by the developer and most importantly the users from different background.

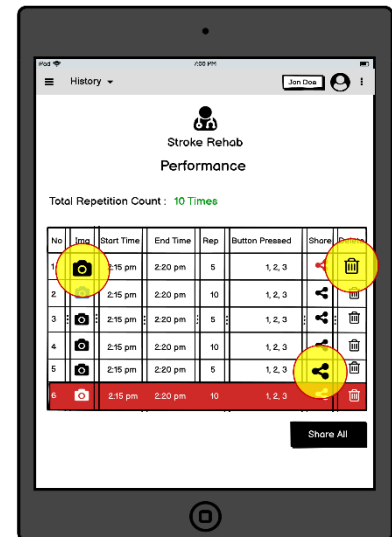


Figure 2: Common Action Icon

### Efficient:

Figure 3 Serves as a better example of the Efficient usability goals discussed in the lecture where the app has sidebar navigation that allows users to navigate through between different screens efficiently. Also in the exercise, the application is guiding the user on what to click next to assist the user to complete the task quickly and efficiently.

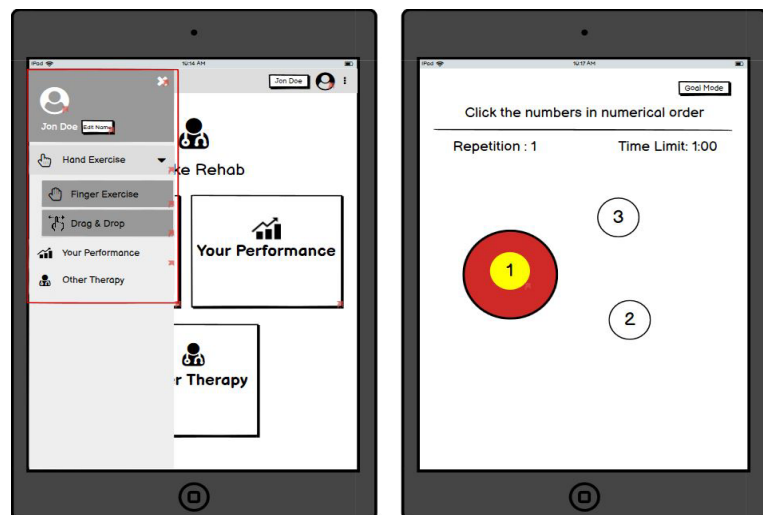


Figure 3: Efficiency of Application

### Failure-resistant:

Figure 4 depicts the example of the Failure-resistant usability goals described in the lecture. The application will alert the user, whenever an action has been taken. Users will have full control of deciding what action to take by clicking between the yes and now an option that reduces the mistake of losing the important data.

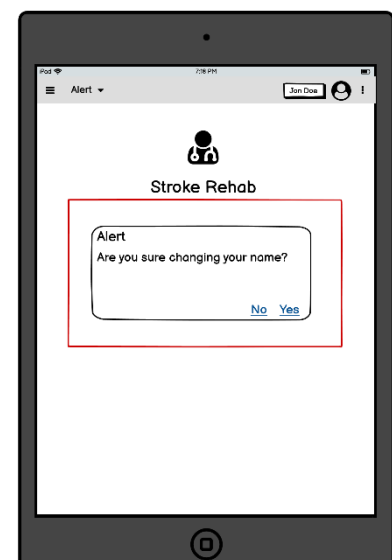


Figure 4: Alert Box, Deletion Confirm

### Forgiving:

Figure 5 shows the forgiving example from the stroke rehabilitation application. Users can easily recover the lost data by clicking undo button which will give the user a second chance to get the data. The data will be stored in the correct file again and the user will be able to take further action on the data.

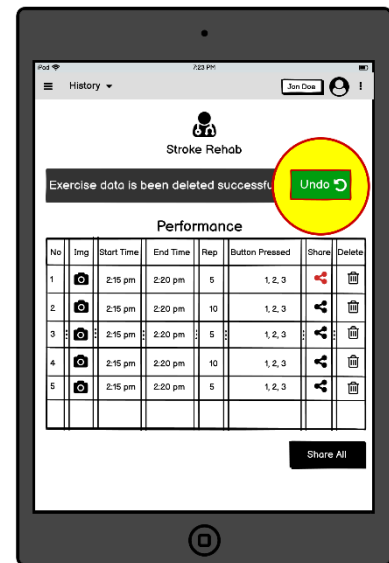


Figure 5: Undo Button, Data Recovery

### Satisfying:

Figure 5 also shows a good example of the satisfying usability goals where user can get their lost data by clicking a single button. That makes the target user satisfied while using the application.

### Design Principle:

#### Visibility:

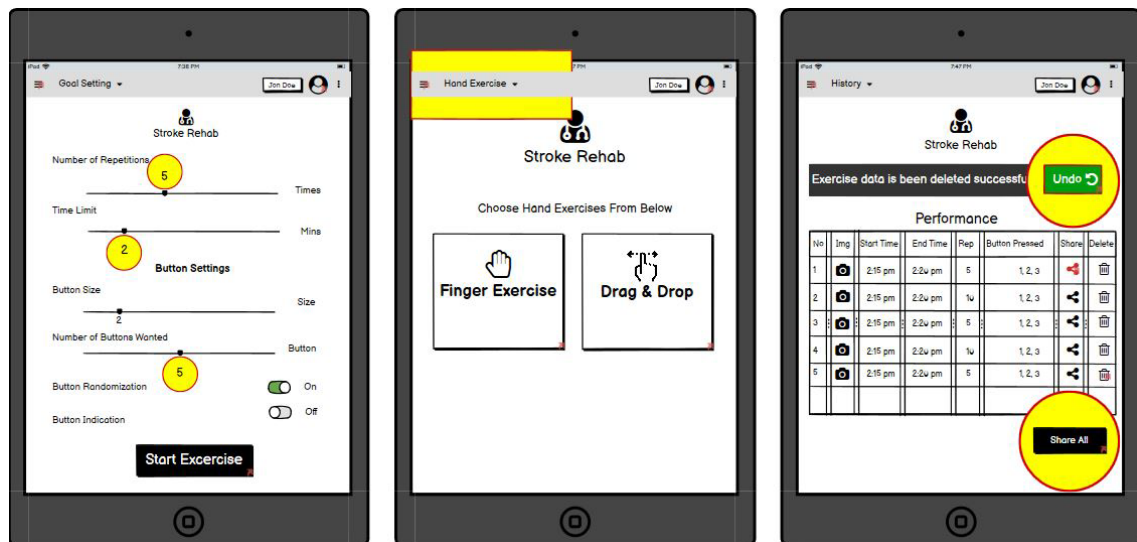


Figure 6: Actions Are Visible

Visibility played a crucial role while designing the stroke rehabilitation app as the target users are stroke patients who might have difficulty seeing the interface elements. Figure 6 shows a good example of visibility where the slider is showing what number the user is selecting, every screen has a visible title that shows where the user currently is, and the important action buttons are visible enough for the user to use whenever necessary.

## Feedback:

Figure 7 shows the feedback example of don Norman's design principle where the user will be able to see the state of the action taken by them. For example, figure 7 has prompt messages that describe whether the data deletion has been completed or not.

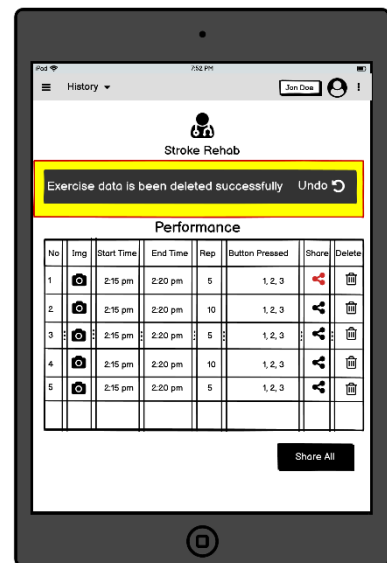


Figure 7: Feedback of Your Action

## Affordance:

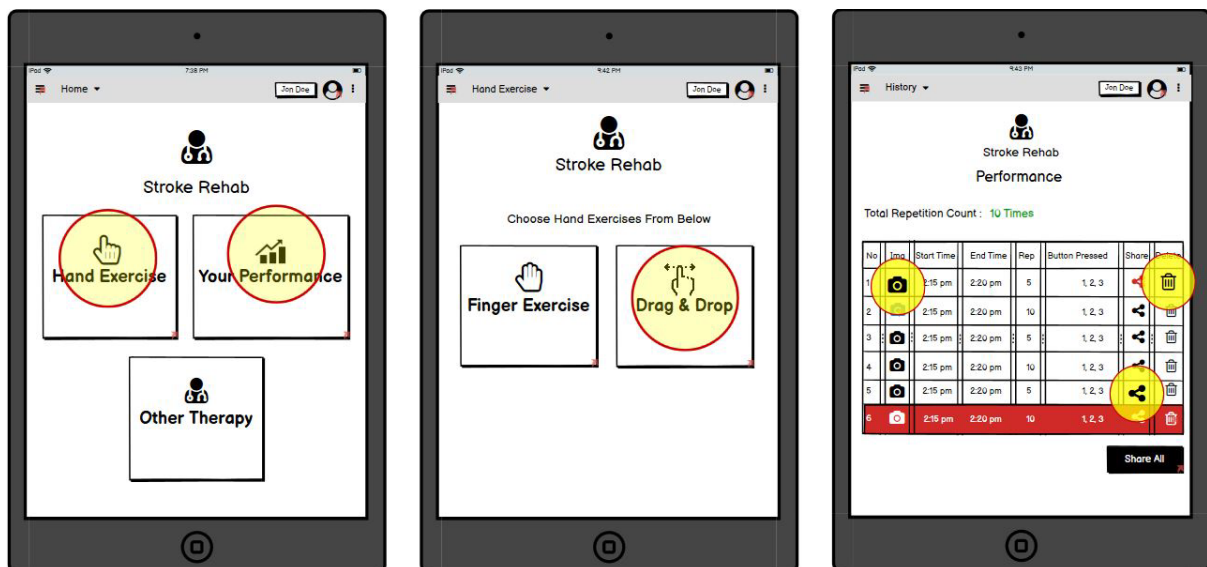


Figure 8: Using Common Icons

Figure 8 is the best example of the Affordance design principle that shows what each functionality has to offer along with its naming. For example, the icons are recognizable and used regularly in most applications around the different platforms like android, iOS, etc. Users will be comfortable with this functionality as they are already knowing what each icon represents.

## Mapping:

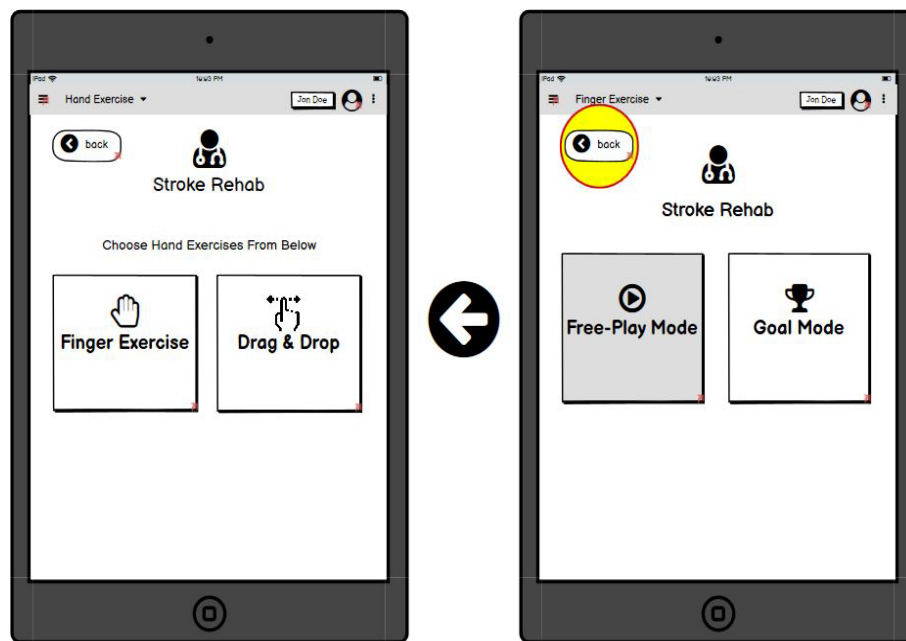


Figure 9: Back Button Mapping

Figure 9 has a back button that is an example of the mapping design principle that has been used in the application. Users can click the back button to go to the previous screen whenever required.

## Consistency:

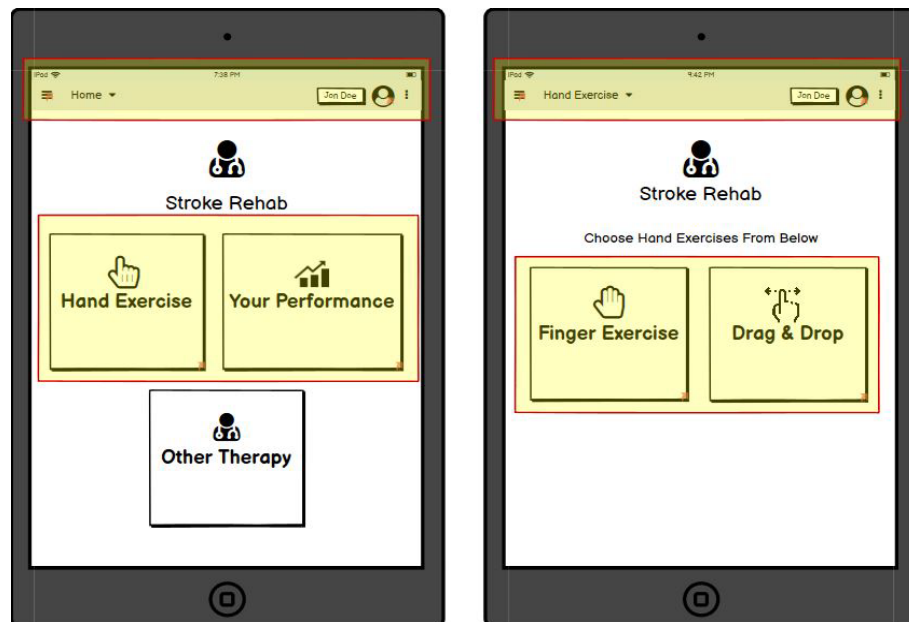


Figure 10: Consistency on application

The most essential design principle for any software is consistency. While designing this application, this design principle has been considered and implemented carefully as it can mislead the user when using the application. In figure 10, it is visible enough that every screen's interface is consistent as it has a similar structure, style, and elements that make it memorable for future usage.

## Testing Methodology

### Think Aloud Testing:

Think aloud testing is the most common and effective testing method used by developers. For this stroke rehabilitation application, think-aloud testing is the best option as the target users are stroke patients. For this application, I have conducted Think-aloud testing. Most importantly, both the qualitative and quantitative approach where the goal of qualitative usability testing is to gather information, insights, and observations about how people use a product or service and on the other hand, The purpose of quantitative usability testing is to gather data that describes the overall user experience. This testing helps the developer to understand each user's mental model and take necessary action. Think aloud test is cheap, fast, flexible, convincing, and easy to learn. There is another testing type that could be done for top-level results which is formative testing. This testing has been done at the start and after the design changes based on findings. This type of testing is particularly useful for finding design problems which makes the application more usable. But for this application, I have chosen a qualitative and quantitative approach that describes briefly below.

### Test Preparation:

- Setting up the room of both facilitator and user.
- Experimenter's Note-sheet is ready.
- The test will be conducted over zoom video conference.
- Instruction, Questionary and zoom link were provided beforehand via email.
- Conversation will be recorded through zoom.
- Design Prototype (balsamic file) and User consent form provided via email.

### Participants Recruitment:

Participants	Age	Gender	Experience in area	Computer Literacy
P1	30	Male	Mobile App Developer (Teaching)	Proficient
P2	27	Male	Mobile App Developer (Teaching)	Proficient
P3	35	Male	Accounting and Regular App User	Proficient
P4	27	Male	Physical therapist	Intermediate
P5	26	Female	Disability Workers and Carer	Intermediate

*Figure 11: Participants Details*

### Introduction:

- Welcoming the test participant and briefing the application short background and the test purpose.
- Assuring that the system is being tested carefully.
- Ensuring participant Confidentiality.
- Assuring Anonymity of reporting.
- Providing the option for the participant to withdraw at any point of during the test.
- Recording will be started with participant permission and ensuring privacy.
- Asking whether the participant have any to ask about the testing.
- Explaining the procedure of the testing and showing example test

### During Test:

- Recording notes on the Experimenter's Note-sheet for each task and the timing.
  - Gathering note on Qualitative segment.
  - Gathering note non-Quantitative segment.
  - Taking note on mental models.
- Assuring the participant feels comfortable during the test.
- Keeping quiet during the test unless required.
- Keeping track of how the participant deal with problems and solve them on their own for future changes.
- Test is recorded for Result analysis.

### Questionnaire/Interview:

#### Post-Questionnaire:

- How would you sum up your overall Experience of the Application?
- What was your favourite aspect of utilising this Application?
- What did you find the least appealing?
- Is there anything in the application that surprised you?
- Do you think this Mobile application can help stroke patient?

#### Observation:

- Taking notes on participator answering above question.
- Observing whether the purpose and functionality of the app is matching with participators.

### Debriefing:

- Thanking the participator for their time.
- Describing the usefulness of their participation on the test.
- Making sure all the tasks are completed and recorded.
- Asking participator to fill up and sign the consent form.

### Usability Test Tasks

- T1: You are a carer for a stroke patient, and you have signed into the app, and you feel like you need to provide the patient's name instead of yours.
- T2: You have updated the name recently and you want to do some hand exercises without any limitations.
- T3: You are bored with the exercise without any goal settings, and you want to challenge yourself by changing the settings and exercise with your own term.
- T4: You have completed your first exercise and like to see your how you are doing with each exercise attempt.
- T5: You are checking your exercise performance and did not like some of the performance and want to delete it.
- T6: You want to go back to previous screens too many times is time consuming and boring, you want to access the hand exercise list without going into different screens.

### Success Requirements

- R1: User should be able to edit their name.
- R2: User should be able to exercise without limitations.
- R3: User should be able to exercise changing limitations (Repetition, time limit, numbers of button, button indication etc.).
- R4: User can check their performance of each attempted exercises and delete each attempted exercise.
- R5: User can access the nav bar to access menu without clicking back button.

### Task Matrix

Task \ Requirement	R1(Edit name)	R2(Free-play Mode)	R3(Goal Mode)	R4>Delete data)	R5(access navbar)
T1	X				
T2		X			
T3			X		
T4				X	
T5				X	
T6					X

Figure 12: Task Matrix

## Testing Results and Discussion

### Reporting Table

Task \ Participants	P1	P2	P3	P4	P5	Mean	Min/Max
T1 (Edit name)	1.12	1.25	1.15	1.10	1.19	1.16	1.10/1.25
T2(Free-play Mode)	1.61	1.50	1.52	1.40	1.36	1.48	1.36/1.61
T3(Goal Mode)	1.27	1.30	1.25	1.29	1.28	1.28	1.25/1.30
T4(Performance Check)	1.07	1.11	1.06	1.15	1.24	1.13	1.06/1.24
T5(Delete data)	0.14	0.12	0.11	0.10	0.10	0.53	0.10/0.14
T6(Access navbar)	1.21	1.28	1.25	1.23	1.24	1.24	1.21/1.28

Figure 13: Reporting Completion Table

Task \ Participants	P1(Pass/Fail)	P2(Pass/Fail)	P3(Pass/Fail)	P4(Pass/Fail)	P5(Pass/Fail)	Overall Result
T1 (Edit name)	Pass	Pass	Pass	Pass	Pass	Pass
T2(Free-play Mode)	Pass	Pass	Pass	Pass	Pass	Pass
T3(Goal Mode)	Pass	Pass	Pass	Pass	Pass	Pass
T4(Performance Check)	Pass	Pass	Pass	Pass	Pass	Pass
T5(Delete data)	Pass	Pass	Pass	Pass	Pass	Pass
T6(Access navbar)	Pass	Pass	Pass	Pass	Pass	Pass

Figure 14: Reporting Success/Failure Table

### Updated Prototype:

The original prototype has been updated after conducting the think aloud test based on the recommendation of the Participant. Below I will discuss the changes that occurred after testing.

#### Recognizable Icon with right naming:

Figure 13 shows a good example implementing of the **memorable on repeat use** goals and **Affordance** design principle.

For example, in the updated prototype I have added icons with each functionality that are used globally and recognized by all kinds of users. Also, I have updated the history into performance that will help the user to understand what to expect inside.

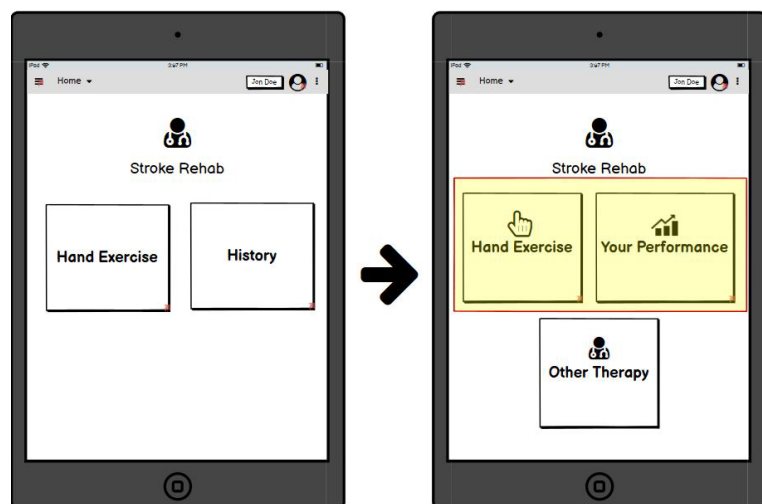


Figure 15: Icon Added



### Back Button Added:

Figure 14 depicts an example of mapping design principles discussed in the lecture. In the original prototype, there was no back button to go to previous screens but only a navbar implemented. Sometimes it is difficult for inexperienced users to understand what the navbar symbol means so the P1 had the same problem that is why after research I have included the back button on each page wherever necessary.

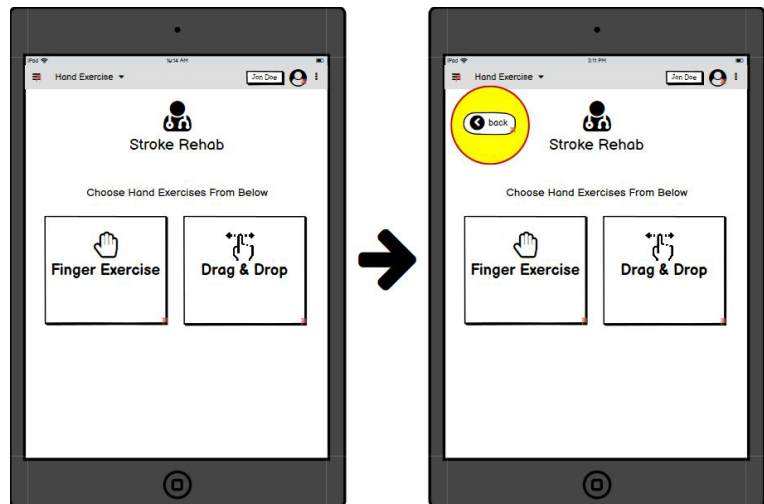


Figure 16: Back Button Added

### Undo Button Added:

Figure 15 shows an example of the forgiving usability goals from lectures. In the original prototype, there was no undo button to retrieve the lost data. But in the updated prototype undo functionally is implemented that will allow the user to recover the data when they mistakenly delete the exercise data.

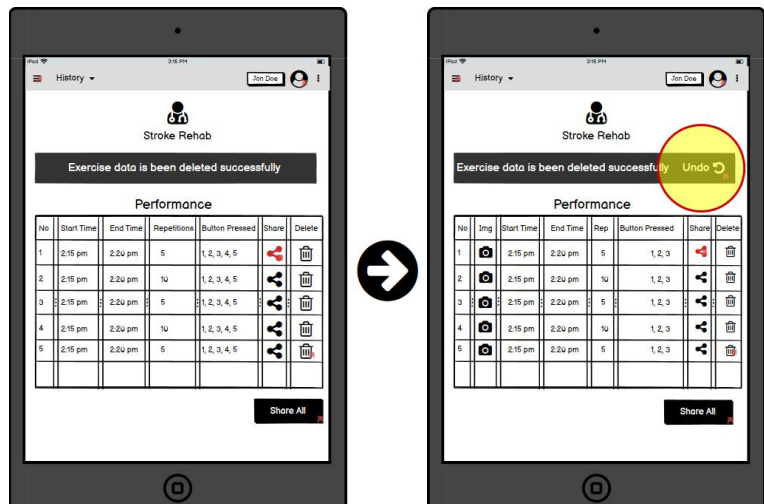


Figure 17: Undo Button Added

## Conclusion

Overall, the experience of designing the stroke rehabilitation application and conducting a Think-aloud test was very good. Firstly, I have learned about the usability goals and Don Norman's design principle which helped me to design the overall application. I have also learned about balsamic wireframe software which helped me a lot with making the low-fidelity prototype as it has all the elements already that I have used in my design. Also, I have learned about the trend that design professional follows while designing the application. The best part was learning about the difference between the android and iOS app designs as they have their structure, style, and elements. On the other hand, the best part was the usability testing that helped me a lot to find the flaws in the design allowing me to update the prototype wherever required. I believe think-aloud testing is the best usability testing method as it is cost-effective, Flexible, convincing, easy to conduct, and most important helps a lot in understanding the mental model of the users. The lecture has covered all the necessary topics that helped me a lot with finishing the assignment. I believe, anyone can replicate my prototype structure and testing method to design and testing as I have followed all the usability goals and design principle.

## References

1. InsightfulHealthcare (2015) *isquio Stroke Rehabilitation*. (Version1.0.1) [Mobile app]. Available at: Google Play (Downloaded: 1 March 2022).
2. Nielsen, J. (2012). *Usability 101: Introduction to Usability*. [online] Nielsen Norman Group. Available at: <https://www.nngroup.com/articles/usability-101-introduction-to-usability/>.
3. Nielsen, J. (2012). *Thinking Aloud: The #1 Usability Tool*. [online] Nielsen Norman Group. Available at: <https://www.nngroup.com/articles/thinking-aloud-the-1-usability-tool/>.
4. Rubin, J. and Chisnell, D. (2008). *Handbook of usability testing: how to plan, design, and conduct effective tests*. Indianapolis (Ind.): Wiley Pub.
5. Lee, V., Schneider, H. and Schell, R. (2004). *Mobile applications Architecture, design, and development*. Upper Saddle River, Nj: Pearson Education.

## Appendices

Participant #	P1		
Task 1	You are a carer for a stroke patient, and you have signed into the app, and you feel like you need to provide the patient's name instead of yours.		
Success	Yes	Only with help	No
Time taken	1.12 min		
Observations	User is feeling comfortable while navigating through to the edit functionality.		
Errors	No Error		
User Comments	There should be edit button with the name so that it's easy to understand where to click change the name.		

Figure 18: Usability Testing Note

Participant #	P2		
Task 2	You have updated the name recently and you want to do some hand exercises without any limitations.		
Success	Yes	Only with help	No
Time taken	1.50 min		
Observations	User is going through each screen to finish the task. User is also navigating using the navbar and finished the task successfully.		
Errors	No Error		
User Comments	The exercise is fun and easy, indication what button to press and showing video tutorial on how to do the exercise.		

Participant #	P5		
Task 5	You are checking your exercise performance and did not like some of the performance and want to delete it.		
Success	Yes	Only with help	No
Time taken	0.10 min		
Observations	User can see the delete option clearly. User performed the task successfully.		
Errors	No Error		
User Comments	The alert box is helpful as it gives the full control to user and rethink whether delete the data or not. Very efficient to use.		

*Figure 19: Usability Testing Note*