Introduction

The piece of software I have designed for this task is an accessibility-focused, user interface for a touchscreen mobile phone. The software is primarily focused on improving the usability of this device type for users who suffer physical impairments that inhibit their motor functions. There are many different conditions that may cause users to struggle with the physical interactions that are required to operate a touchscreen device effectively. Though the users who are affected by such impairments are a wide and diverse group, there are common issues that they all face. Research I have carried out prior to the development of this prototype indicated that users with impaired motor functionality took significantly longer than non-impaired users to complete the same tasks. The app shall be designed to reduce the time it takes to perform key functions involved in the operation of a touch screen mobile phone.

Testing and further development

The development of this prototype piece of software will be an iterative process. After each iteration of the prototype I will test the software with a potential user, evaluate the data and feedback acquired and then make modifications based on the results. To help me with my research, I have found a potential user who has agreed to give me their time, and participate in the testing of this prototype. The user is a 27 year-old male who suffers from Cerebral Palsy.

In order to determine the efficacy of the application I have devised a number of tests designed to produce both qualitative and quantitative results. The first series of tests will measure the user's physical adeptness when it comes to performing tasks within the software, by measuring the time taken to complete each task. For comparison, the same timed tasks will also be performed by a non-impaired user. The tasks are designed to mirror real-world scenarios and operations that users are likely to encounter in their day to day use of such a device.

The second testing phase will be used to evaluate the user's perception of the application through a series of questions designed around the principles of Nielsen's Heuristics and some key principles of usability. The questionnaire has been inspired by the SUS questionnaire developed at the Digital Equipment Corp, and includes 12 questions. The first 10 questions the user shall answer using the likert scale (strongly agree to strongly disagree). The final two questions will be open-ended and are designed to allow the user to provide additional feedback that may not have been covered by the initial 10 questions. The questions have been worded as neutrally as possible so as to remove any potential bias or influence they may impart on the user's feedback.

Test 1: Answering a phone call.

Research has shown that users who suffer from impaired motor functionality take significantly longer than non-impaired users to complete the same tasks. While many operations that users may perform on such devices are not dependent on time, and can be completed at the user's

own pace, there are some tasks that will require the user to complete their input within a certain amount of time. One obvious example of this is answering a phone call. In order to better model a real-life scenario for this test, I have asked the user to place the device in their pocket and then remove it and answer the call. The timer will begin as the phone starts to ring, and will stop once the user has removed the phone from their pocket and pressed the “Accept” button on the screen.

Test 2: Opening an application

In order to complete this task the user is required to navigate from the home screen, to the “apps” section, then select an application to open. For consistency I will require the user to open the same app each time. The timer will start when the user is on the home screen and will stop once they press the icon for the application they are required to open.

Test 3: Making a call.

This test is designed to measure the time it takes to perform another key operation for this device - making a phone call. The user will begin this test on the “home” screen, and will be required to navigate to the “contacts” section, select a contact, and press the “call” button. The timer will begin on the home screen and will stop once the user has pressed the “call” button.

Results

Non-impaired user results are in brackets in red.

Version 1.0

Test number	Answering Call	Opening an App	Making a call
1	9.32s (5.23s)	6.32s (3.45s)	8.12s (5.06s)
2	8.78s (6.33s)	6.98s (3.66s)	8.97s (5.14s)
3	10.22s (5.87s)	6.01s (4.17s)	9.41s (5.87s)
4	9.87s (4.98s)	7.13s (4.12s)	9.03s (4.92s)
5	11.13s (4.66s)	6.88s (3.23s)	8.67s (5.36s)
6	8.65s (5.02s)	5.99s (3.57s)	8.32s (5.63s)
7	8.78s (5.36s)	6.54s (3.84s)	9.15s (5.27s)
8	9.24s (5.07s)	6.75s (4.32s)	8.91s (5.38s)
9	10.11s (5.16s)	7.12s (3.72s)	8.72s (4.30s)
10	9.89s (4.59s)	7.45s (3.21s)	8.69s (4.95s)
Average	9.60s (5.23s)	6.72s (3.73s)	8.80s (5.19s)

Questionnaire:

1: I liked the design of this application.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

2: I felt lost when using this interface.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree

			x	

3: The application was easy to use.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

4: I feel like this application could help someone with a disability.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

5: I felt like all the elements of this app worked well together.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

6: It was clear and obvious what options were available to me.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
		x		

7: If I made a mistake I could get back on track easily.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

8: I felt overloaded with information.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
				x

9: I could easily find what I was looking for.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
x				

10: I would use this application again.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

11: What did you like most about the application?

I liked that there were only a few icons on the page. I can read and see all the icons fine on a normal phone, but when I try to press the one I want sometimes I press the wrong one by mistake. When there are less on the screen it makes it easier for me to press the right one.

12: Is there anything you feel would improve your experience when using this software?

It’s not a huge problem for me but I think that some people might find it difficult to use their finger to swipe up and down or left and right. Maybe if there were some buttons to go up and down or to the next page that would make it easier for some people.

Evaluation of version 1.0

Overall I am very happy with how the initial testing phase for the first version has gone. The user was able to perform all of the three tasks I designed and seemed to respond well to the design of the interface. The user has generally responded positively to the statements in the questionnaire and seemed to think that the idea of an app like this was a good one. When asked what they liked most about the application, the user commented that the reduced number of icons on each screen was beneficial to someone with their disability, not necessarily because they would not be able to interpret what was on the screen if there were more icons, but rather from a physical perspective as they said it is easier to select the correct icon when there are fewer icons that could potentially be pressed in error. The user also suggested that additional buttons could be added to help with navigation through certain screens. I agree that this is a

good suggestion; however, I have decided not to implement it in the next version as I would prefer to investigate whether an increase in the size of the icons has an effect on the speed at which the user can accomplish each task.

Version 1.1

Change-log:

- Increased size of all buttons by around 12%
- Repositioned button descriptions so they are now within the button itself.

Test number	Answering Call	Opening an App	Making a call
1	8.76s (5.01s)	5.89s (3.22s)	7.80s (4.86s)
2	8.23s (5.82s)	6.34s (3.32s)	8.43s (4.95s)
3	9.87s (5.29s)	5.51s (4.02s)	8.89s (5.54s)
4	9.02s (4.55s)	6.62s (4.12s)	8.45s (4.76s)
5	10.54s (4.06s)	6.21s (3.34s)	8.12s (5.13s)
6	8.33s (4.61s)	5.76s (3.08s)	7.94s (5.59s)
7	8.12s (4.72s)	5.80s (3.65s)	8.88s (5.23s)
8	8.78s (4.28s)	6.22s (4.23s)	8.27s (5.45s)
9	9.12s (4.39s)	6.77s (3.58s)	8.23s (4.09s)
10	9.59s (4.16s)	6.94s (3.22s)	8.02s (4.38s)
Average	9.04s (4.69s)	6.21s (3.58s)	8.30s (5.00s)

Questionnaire:

1: I liked the design of this application.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

2: I felt lost when using this interface.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
			x	

3: The application was easy to use.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

4: I feel like this application could help someone with a disability.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
x				

5: I felt like all the elements of this app worked well together.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

6: It was clear and obvious what options were available to me.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
		x		

7: If I made a mistake I could get back on track easily.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
x				

8: I felt overloaded with information.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
				x

9: I could easily find what I was looking for.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
x				

10: I would use this application again.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

11: What did you like most about this version of the application?

Having the text inside the buttons made it look a bit neater. I felt like the larger buttons made me a bit faster.

12: Is there anything you feel would improve your experience when using this software?

I felt faster with the larger buttons so maybe if they were even bigger it would help more. I know there maybe isn't much space left on the screen but still it might help.

Evaluation of version 1.1

I am pleased with the results from this version. The increase in button size improved the times for both users, more so for the motor-impaired user than the non-impaired user. The user answered slightly more positively than in the previous version, when it came to using the likert scale. The user also commented that aesthetically, the software was improved by moving the text inside the buttons. I had originally done this because there was limited space between the

buttons. One request that the user made was to increase the button size even further, I am not sure if this would be possible with the current layout. For the next version I will explore the possibility of altering the layout slightly to accommodate even larger buttons.

Version 1.2

Change log:

- Altered the layout to completely remove white space.
- Further increased size of menu buttons by around 20%.

Test number	Answering Call	Opening an App	Making a call
1	7.45s (4.89s)	4.99s (3.24s)	6.89s (4.76s)
2	7.22s (5.76s)	5.43s (3.35s)	7.65s (4.56s)
3	8.92s (5.32s)	4.97s (4.21s)	7.98s (5.65s)
4	8.04s (4.25s)	5.20s (3.95s)	8.03s (4.69s)
5	9.34s (4.51s)	5.68s (3.03s)	7.58s (5.02s)
6	7.59s (4.21s)	4.94s (3.02s)	7.12s (5.41s)
7	7.24s (4.02s)	5.47s (3.54s)	8.01s (5.43s)
8	8.07s (4.31s)	5.85s (4.10s)	7.83s (5.12)
9	8.76s (4.26s)	6.01s (3.23s)	7.66s (4.32s)
10	8.68s (4.23s)	6.05s (3.47s)	7.42s (4.09s)
Average	8.13s (4.58s)	5.46s (3.51s)	7.62s (4.91s)

Questionnaire:

1: I liked the design of this application.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
x				

2: I felt lost when using this interface.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
				x

3: The application was easy to use.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
x				

4: I feel like this application could help someone with a disability.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
x				

5: I felt like all the elements of this app worked well together.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

6: It was clear and obvious what options were available to me.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

7: If I made a mistake I could get back on track easily.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
x				

8: I felt overloaded with information.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
				x

9: I could easily find what I was looking for.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
x				

10: I would use this application again.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
	x			

11: What did you like most about the application?

I think this is the best one yet, making the buttons full-size seems like it made me a lot faster and it also looks a bit nicer than the other ones, I think. It looks a bit more modern this way I think.

12: Is there anything you feel would improve your experience when using this software?

I think it is good compared to the normal settings on a phone, so it does its job well. I suppose you can always make something a bit better.

Final Evaluation

The latest version has performed the best out of the three so far. The recorded times for each task are lower than they were for the previous two iterations, both for the impaired and non-impaired users. The impaired user showed a much greater improvement between the previous and final versions than the non-impaired user did. As I had discovered during the literature review I conducted prior to the development of this prototype, increasing button sizes will only improve times for non-impaired users up to a certain point, after which an increase in size has no measurable effect on the time taken to complete a task. This is not the case for impaired users who continued to show an improvement in speed as button sizes increased beyond the size at which speed plateaued for non-impaired users. If we take a look at the average times for each task from each version, you can see that there is a greater improvement for the motor-impaired user than the non-impaired user.

Version	Answering a call	Opening an App	Making a call
1.0	9.60s (5.23s)	6.72s (3.73s)	8.80s (5.19s)
1.1	9.04s (4.69s)	6.21s (3.58s)	8.30s (5.00s)
1.2	8.13s (4.58s)	5.46s (3.51s)	7.62s (4.91s)

The results show that from version 1 to 1.2 the motor-impaired user experienced a reduction of around 1.4 seconds in the time it took to complete each task, while the non-impaired user's times were reduced by around 0.25 seconds.

Wireframes