NorwichTravel: developing usable software

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Abstract

As technology becomes more accessible and prevalent in today's society, the demand in industry for mobile applications to be accessible to all potential users is growing. NorwichTravel is an app built in React Native with a focus on ease of use. Specifically handling users who are visually impaired and might posses limited motor skills.

1 Introduction

In this report we will explore what it means for a Mobile Application (app) to be usable and accessible to all potential users. Specifically looking into the industry standard guidelines related to Mobile Applications. Then we follow the development cycle of NorwichTravel as it progresses to be increasingly more user friendly and accessible. Finally we will examine techniques and methods for testing the accessibility of an app, as we perform them on NorwichTravel, to discern what improvements could be made in the future to improve NorwichTravel.

Usability is defined as "How effectively, efficiently and satisfactorily a user can interact with a user interface"; whereas *Accessibility* is defined as "The measure of a web page's usability by persons with one or more disabilities" [Government, 2013]. The difference between the two is that accessibility is about usability for those with disabilities.

In order to develop an app that is accessible we must first develop the app to be usable. Once that has been achieved the development is a balancing act between maintaining usability whilst integrating accessibility, at the same time keeping the integrity of the design.

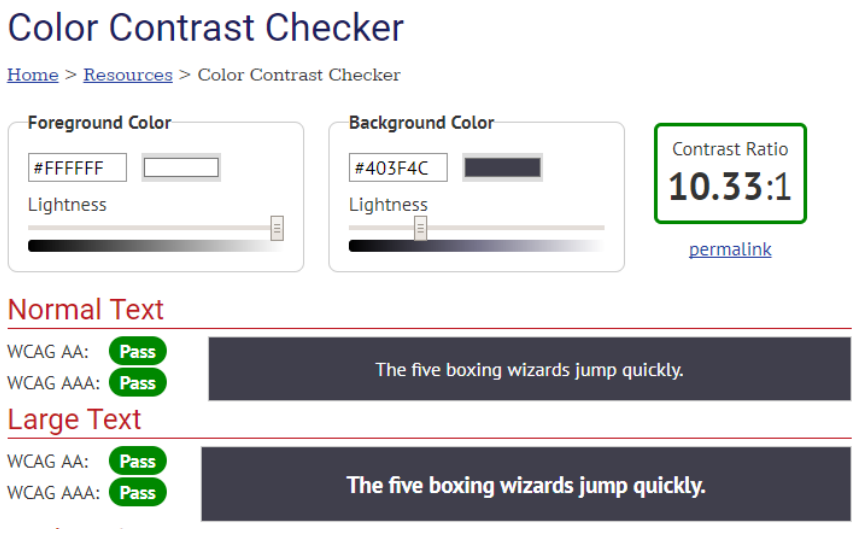
1.1 Scenario

NorwichTravel will be developed using a scenario; which is a quick and easy way to define the features of a service, so that the scope of the project does not expand.

> Steve is a student at UEA and it is the end of the semester. He has just submitted his last assignment and one of his friends, Sally, suggests that they go out tonight. Sally, who is visually impaired, wants to go and get dinner in town, see a film and grab a couple of drinks with her course mates before everyone scatters for the holidays. They want to get the bus into town, but will likely need a taxi back after spending a couple of hours in the pub. Steve also needs to go back for the Christmas Holidays during the weekend, he normally has his train ticket booked up by now, but this year he hasn't. So he will need to check what trains are heading to Cambridge from Norwich. The group of friends break up to leave their bags at their respective houses and agree a time to meet in town. Knowing that the bus will take around 20 minutes to get into town, Sally needs to find out what time the bus will be at the stop so that she doesn't have to wait out in the cold for longer than she has to.

2 Usability and Accessibility

As we learned in Section 1, there is a three-way balancing act between design, usability and accessibility. These elements can and do complement each other in many ways, but should one take priority during the development of a system, the other two will suffer immensely. In this section we will examine the individual elements "balancing act" in detail, in addition to why it is important that app developers should concern themselves with such a task.



Color Contrast Checker

Home > Resources > Color Contrast Checker

Foreground Color: #FFFFFF

Lightness

Background Color: #403F4C

Lightness

Contrast Ratio 10.33:1

permalink

Normal Text

WCAG AA: Pass

WCAG AAA: Pass

The five boxing wizards jump quickly.

Large Text

WCAG AA: Pass

WCAG AAA: Pass

The five boxing wizards jump quickly.

Figure 1: A screenshot taken from [WebAIM, 2017] displaying the results from checking the Colour Contrast on NorwichTravel. The hex codes for the two main colours of the design is entered into the "Foreground Color" and "Background Color" boxes, the results are displayed below.

2.1 Why is Usability and Accessibility Important?

The price of smartphones has drastically fallen worldwide (with the exception of the United States, where we can observe a small increase) [Statista, 2017]. This means that smartphones, and the apps that can be used on them are becoming increasingly accessible. As more users can access a smartphone the percentage of users who live with some sort of disability increase [Ofcom, 2017]. These disabilities can range from an elderly individual with diminishing eyesight to someone who suffers from a serious affliction such as motor neuron disease. As well as accessibility increasing importance, the falling prices of smartphones also bring entirely new users into the user base. If the apps that they want to use are not usable they will quickly move on in frustration.

Due to this change in the user base, developers need spend more of their resources catering for them. Services that do not devote sufficient resources to integrate accessibility and usability features, are essentially denying themselves potential users. 13 million people in the UK have some kind of disability, which is $\frac{1}{5}^{\text{th}}$ of the population [Living Foundation, 2017]. This does not only to app developers, web developers need to make their websites as usable and accessible as possible.

2.2 Industry Guidelines

With the user base changing for the web and app industries, the consensus is that Usability and Accessibility is indeed important and there should be metrics and guidelines in place to ensure that the disabled user base is looked after in the proper manner. The World Wide Web Consortium (W3C), "an international community where Member organisations, a full-time staff and the public work together to develop web standards." [Berners-Lee, 2017], developed a set of guidelines (including metrics) for web developers to follow. These guidelines are known as the "*W3 Accessibility Guidelines*" [Consortium, 2017]. Whilst these guidelines are principally aimed towards websites, there is a dedicated section to mobile usability and accessibility including a separate set of metrics. In addition to the guidelines, there are several services that serve to check if your website (or app in some cases) comply with the W3 Accessibility Guidelines. One such example is the WebAIM: Color Contrast Checker, seen in Figure 1 [WebAIM, 2017].

2.3 Considerations towards Developers

Usability and Accessibility is not an issue that concerns only the users of a system. The developers have to invest significant time and resources into integrating Operating System level features, such as the iOS Magic Touch, into their apps. Unfortunately, many developers underestimate the increase in complexity that accessibility brings. This can lead to projects being exceeding their budget and time limits.

This is why for the development of NorwichTravel, React Native was chosen. React Native is a cross platform JavaScript library that has integrated many of the Operating System level accessibility features into itself [Facebook, 2017]. Due to this integration, we can override the default screen readers with more informative labels, or set the iOS Magic Tap to perform specific tasks, both of which will be addressed in greater detail in Section 3.

3 NorwichTravel

As we learned in Section 1.1, NorwichTravel was developed through the use of a Scenario. The Scenario is broken down into a list of *User Stories* that is then translated into a list of functionality for the app. There are two main advantages to developing through Scenarios; it is a simple method to generate functionality, but more importantly it places the user at the centre of the app from the very start of the development cycle. See Section 3.1 for a full list of proposed functionality from the Scenario.

From Section 2.3, we learned that NorwichTravel is a React Native app. Allowing for easy Cross-Platform (iOS and Android) support and rapid prototyping when used in conjunction with services such as Expo [Expo, 2017]. In addition to the support that React Native has for accessibility functionality (see Section 2.3).

3.1 Proposed Functionality

NorwichTravel is an app that provides public transport information for Norwich. The three principle forms of public transport within Norwich are Buses, Trains and Taxis. Below is the list of functionality related to information about the aforementioned public transport:

- Look up Bus Times from a Bus Stop within Norwich.
- Look up the next Train Times from Norwich Station.
- Look up the time of the next Train from Norwich to a given location.
- Find a list of Taxi companies that operate within Norwich.

3.2 Target Audiences

From the Scenario in Section 1.1 we can tell that NorwichTravel is aimed principally at the Students of UEA. However, NorwichTravel can be used by anyone who needs by transport information within Norwich, be it Business Personnel on a trip to Norwich or a tourist passing through whilst exploring the Norfolk Broads. This means that we are looking at a very diverse user base. Individuals of all backgrounds and skill sets could use NorwichTravel. Therefore the design of NorwichTravel must be focused on Usability.

3.3 Documentation Overview

ReactNative vs React Vanilla API System Structure CI Testing

4 Designing for Usability and Accessibility

As we discussed in Section 2.2, there is a set of guidelines provide assistance to developers when integrating accessibility features. In addition to the W3 Accessibility Guidelines, the BBC have released a comprehensive guide to accessibility in apps [BBC, 2016].

In this section we will discuss some examples from these two guidelines and how they relate to NorwichTravel, with a further investigation into the compromises made to conform to the industry standard guidelines.

4.1 Conforming to Guidelines

Guideline 1: Colour Contrast - mentioned in both of the guidelines we are concerning ourselves with. A ratio of **4.5:1** is supplied that reflect the contrast that should exist between the Foreground Text and Background Colour. To conform to this guideline we aimed to have the colour scheme of NorwichTravel double this metric, having a minimum contrast **9:1**. This makes NorwichTravel highly accessible to those who are visually impaired.

Guideline 2: Touch Target Size - inspired by the W3 Accessibility Guidelines and expanded by the BBC Mobile Accessibility Guidelines. The metric to aim for is a touch target area (i.e. a button) must be between **7-10mm height and width**. In addition to the expected design elements such as the buttons must not overlap.

Guideline 3: Text Size - defined within the mobile section of the W3 Accessibility Guidelines, it dictates that the default text should be able to be doubled in size without loosing content. NorwichTravel text was defined with this in manner and text will wrap to prevent any loss of content.

4.2 Compromises Made

NorwichTravel was designed with Usability and Accessibility in mind from the conception of the app. Due to this the design compromises that to be made were minimal. Those that had to be made are the expansion of the Train *search component* and the choice of React Native.

The *search component* within NorwichTravel is shared between both the Bus and Train containers. The Bus container only takes an origin for the search function. The Train screen however can take either an origin or an origin and destination combined. This subtle change in the search component functionality caused the developers measurable increase in hours spent on the project. The compromise here is that whilst it might be easier to implement two search components, in terms of maintainability it was better to have one - despite the increase in development time.

The choice of React Native was a compromise between the ease of development and the ability to access the operating system native accessibility features. This allowed NorwichTravel to respond to the system settings for text size and allowed the developers to set specific labels for the screen readers to vocalise.

5 Evaluating NorwichTravel

NorwichTravel used Continuous Integration (CI) and Continuous Deployment (CD) tools such as Expo and CodeShip [CodeShip, 2017]. This allows for the latest version of the app to be tested without the developers having to manually redeploy after each commit to the GitHub repository.

The general methodology for testing was to use the industry standard tools when possible (see Section 5.3), the “glasses” test as often an possible (see Section 5.2) and Think-Aloud evaluations during milestones within the project (see Section 5.1.1). Milestones for NorwichTravel are defined by major features being "completed". For example; the bus search functionality working would be a milestone, and would be the testing of the bus search would include a Think-Aloud Evaluation. Prototyping was used at the start of the development cycle (see Section 5.1), to avoid costly and time consuming mistakes further into the project.

5.1 Prototyping

Lo-fi prototyping involves sketching the design of a system on paper, whilst producing labels to overlay the design to mock how the final system will operate. As stated in Section 5, the lo-fi was used at the begining of the development cycle to quickly refine the initial concepts. These prototypes can be seen in Appendix A.1.

Med-fi prototyping was used throughout the development process through the use of emulators such as Genymotion and Simulator. This allowed the developers to "live preview" the changes they were making as if they were running on a mobile device. The emulator tools could mimic a large range of mobile devices so that all screen sizes could be tested.

5.1.1 Think-Aloud Evaluation

5.2 "Glasses" Test

Both of the developers working of NorwichTravel posses diminishing eyesight. At the suggestion of the Project Supervisor, one of the principle testing methods that was employed throughout NorwichTravel's development cycle was the "Glasses" Test. A developer to load the app on a phone, through Expo, and remove their glasses. The phone would be positioned in such a way that it became hard to see. The developer would have to then complete a set of tasks with and without the screen reader active. Any issues that were encountered could be noted immediately by the developer.

This test proved extremely effective, due to its similarity to the Think-Aloud Evaluation. The crucial difference is that the developer does not have to convey their thoughts to an evaluator. Instead they can note down the issues they encounter in a manner that makes sense to them and then immediately act upon them.

5.3 Industry Tools

As we learned from Figure 1, WebAIM's contrast checker was used to certify that NorwichTravel was accessible to those with visual impairments.

Unfortunately, there is not a strong ecosystem for automated mobile app usability and accessibility testing.

6 Issues within NorwichTravel

One of the largest issues within NorwichTravel was the state of affairs with React Native's conditional rendering.

6.1 Addressing Issues

6.2 Open Issues

7 Conclusions

7.1 Was NorwichTravel fit for purpose?

7.2 Was NorwichTravel accessible to the target user groups?

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A Prototypes

A.1 Lo-Fi

IMAGE OF LO-FI HERE!!!!!!!

A.2 Med-Fi

IMAGES OF MED-FI HERE!!!!!

B UML Diagrams