

Niceway.to

Crowd Sourced Scenic Route Sharing

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I hereby declare that this dissertation is all my own work, except as indicated
in the text:

Signature _____

Date ____/____/____



Abstract

Project abstract

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1 Introduction

In recent years, the technologies behind satellite navigation and routing services have greatly advanced, allowing them to produce the quickest route between two points in only a few seconds, even with technological limits [15]. As a result, travelling via car is quicker and easier than ever before, and many drivers are now focused solely on reaching their destination as quickly as possible. This has resulted in a shift in the mindset of society where the scenery that we pass on the road is simply a buffer between segments of our day, and it's beauty is left unappreciated. This mentality promotes a culture of instant gratification, impatience, and self-involvement among the driving community, which has a huge detrimental affect on drivers, where any interruptions on their journey are cause for anger. In fact, it has been shown that since 1990, incidents of aggression during driving has risen 51% [28].

Some research has already been completed in an attempt to shift the focus of driving from simply travel, to also being an enjoyable recreational activity. This includes work such as recommending “nice” routes (determining this using social network data [22][27][23]) and how to personalise routes that have been deemed “efficient” [5]. Outside of the world of research, many services already exist that provide users with a collection of scenic routes between two locations. The purpose of these services is to encourage drivers to enjoy the experience of driving more, and be exposed to more of their surroundings. Examples of these include Google’s “My Maps”[1], MADMAPS[2], and MyScenicDrives[3], which are discussed further in section 3.1.

Unfortunately, these systems have some flaws that mean they do not fully solve the above problem, and therefore have not made a huge impact. The largest two being the method of delivery, and the inability for of users to contributions content. Google’s “My Maps”, and MyScenicDrives are optimised for desktop browsing and their support for mobile devices is limited. This is a large portion of users lost, considering that in the United Kingdom 33% of Internet users believe that smartphones are the most important device for going online[21]. MADMAPs, whilst mostly focusing on the selling of physical maps, does also provide a mobile application, but this is clunky, and poorly designed. Alongside these larger flaws, some other minor flaws are also present, including small user bases, primitive search functionality, slow and unresponsive webpages, and some services costing money.

Niceway.to has three main aims: to build a community of travel enthusiasts, improve the travelling experience of those that use it, and allow for users of all skill groups to access it. It will provide a way for users to discover scenic and visually interesting routes between two locations, all of which have been provided by other members of the community. These routes will each contain a social commentary, with users being able to rate them, comment on them, and share them (these will be incentives for users to provide quality content, and to remain loyal to the site). To address the problem of previous software systems, mainly the method of delivery, it will be built as a fully-responsive web-application that functions equally well on desktop and mobile devices.

As a final note, it should be mentioned that this project will not be focussing on the classification of whether or not routes are “nice” or “scenic”. Instead, the content will be entirely user driven, with the assumption that they would only contribute routes that are interesting and visually appealing. To further encourage this, a rating system for routes will be implement, so that “better” routes are more visible than those deemed less so.

2 Motivation

Niceway.to is an application envisioned by my client, Matthew Pike, who works for a small start-up in China. The project has already been worked on once before, but the end result was not to a standard that my client was content with. As a result of this, he would like for the project to be redesigned and recreated from scratch, as little of the original software is reusable.

The main motivation of this project is to change how we think about driving: from simply a tool for travel, to an enjoyable recreational activity, where, instead of being focused solely on reaching our destination, we can take time to appreciate the beauty in the world around us. In a 1995 study, almost 90% of motorists had experienced some form of road rage within the preceding 12 months, and 60% admitted to losing their temper whilst behind the wheel[10]. To facilitate the proposed shift in mentality, this project will be a tool that offers a collection of user submitted scenic driving routes, with a heavy focus on utilising the social characteristics of the Internet. The idea being that when a user wishes to travel somewhere, they could do so by travelling a route lesser known to them. This route may be slower, but would make up for the time lost, by providing a visually enriching experience that the driver would have otherwise been deprived of, and to help avoid common annoyances on the road. This would also help to relieve the monotony of driving the same, mundane, routes repeatedly - which has been shown to have serious implications in terms of accident causation[26].

A big part of this project, which my client has stressed, is to foster a community of travel enthusiasts. Specifically the ability to have a social commentary surrounding each route, where registered users of the application are able to express their opinions on the content, give a numeric rating for the content, as well as share the content (both internally and externally). The reason for this is because a user is far more likely to return to, and remain engaged with, a website if there are other users doing the same, especially if they are directly communicating with those other users[14]. Allowing users to submit their own content coaxes them into feeling more of a connection to the site, and will increase their chance of returning (so that they can check how well received their content is). It has been shown that feedback is a useful tool to boost engagement[20] and hopefully this will encourage users to associate the site with positive experiences, and inspire them to produce quality content (in order to receive more of this feedback).

In order for this community to thrive, it is vital that the system is simple to use, open to users of all skill groups, and easy to access. Therefore, it is important that HCI principles are kept in mind throughout every step of the design and implementation processes. Key to a good design, is simplicity. This is because complex user interfaces frustrate users, and can deter them from returning. Studies have shown that users lose more than 40% of their time to frustration, and in most cases the user ends up angry at themselves, angry at the computer, or left with a feeling of helplessness[13].

In addition to all of these reasons, I feel personally motivated to ensure that this project succeeds. As someone who does not currently drive, I find myself in need of others to drive me when public transport proves inadequate. As a passenger, I will often observe the driver becoming evermore agitated with other drivers on the road, and seeing this problem first hand helps enforce my feelings of the importance of solving it. Driving is a freedom, but one that is being squandered and perceived more as a chore than an enjoyable activity.

MyScenicDrives, <https://www.myscenicdrives.com>

MyScenicDrives is a website that allows users to search for scenic routes by city, state or zip code (currently the service is only available in the United States), and view extremely detailed information about these routes. This includes a very lengthy explanation of all the things that can be seen and done on the journey, interesting facts about the locations visited, all the roads that will be driven on, the best seasons to take the journey during, and even which service stations will be passed. This extremely rich content is the main selling point of MyScenicDrives.

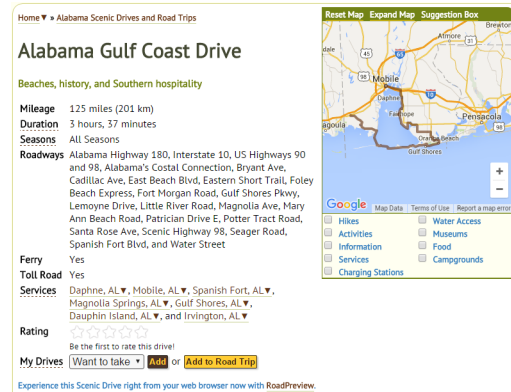
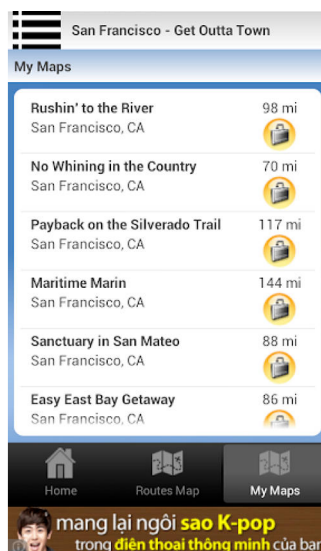


Figure 2: MyScenicDrive's route details

However, no matter how high the quality of this content it, there is still a glaring problem with MyScenicDrives: the quantity of routes. This may be due to the huge amount of information required for a route to be accepted onto the site, but essentially makes the entire application useless. As an example, a search for all routes in the state of Alabama returned a single result. In addition to this, the search functionality itself is very primitive. There is no option for users to select where they wish to start or end their journey, and instead they can only pick a large geographic region. Which would not be suitable for Niceway.to, which aims to provide a way for users to find routes between specific locations.

Mad Maps, <http://madmaps.net/>

The final mapping website that was investigated was Mad Maps, which differed from the others in that it allowed users to purchase physical maps, which they could also view on their mobile phones. One useful feature of the service was the ability to download routes directly to a mobile device, so that the user's Internet connection did not become a limiting factor during a journey. However, it is difficult to ignore the biggest downfall of this service, which was the cost associated with it. All of the maps had a price associated with them, and there was no ability to preview the maps before purchasing. This blind investment could be off-putting for many users, as they may be unsure if they will even enjoy the routes provided. Further to this, the mobile application both required an upfront payment to download, as well as containing adverts within it: which seems unjustified when the majority of the Mad Maps applications had very poor reviews.



The service works by having a group of “experts” compile the maps, and distribute them to the users. This is supposed to instill confidence of their quality, but instead takes out a huge part of travelling, which is the social experience. The only social interaction that users can have with Mad Maps, is the ability to upload photos of waypoints that they have visited, but these will then only be seen by other users that have purchased the route, and would not help to foster the community that Niceway.to is striving for.

Figure 3: List of Mad Maps routes

3.2 Platforms and Tools

This section introduces some potential platforms and tools that could have been used in the project, along with justifications for and against them. The system consisted of the back end and server technologies, as well as some user-friendly front end. Tools and frameworks and languages for both of these parts were evaluated to determine which would be the most appropriate. A full list of the final decisions of tools to use, including their justifications, can be found in section 6.1.

3.2.1 Native Mobile Applications VS Responsive Web Applications

Before investigating technologies to use, it was important to determine what kind of application was to be developed, as this would radically change the tools required. Ultimately, it was decided that it would be better to build Niceway.to as a responsive web-application, but the advantages and disadvantages of both approaches have been discussed below.

Native Mobile Application

Native mobile applications are applications that are downloaded onto a mobile device, and run directly on the hardware. These applications generally have greater exposure, because they are distributed through the application marketplace for the given operating system, and can be reviewed and rated by users. There are several advantages to developing a native mobile application including: the ability to implement multiple pricing models (payment for download, in-application purchases, free with advertisements, or entirely free), after the initial download they can be used without an Internet connection (as data can be downloaded to the phone and accessed later), and the native technology and hardware of the phone can be utilised to provide a better experience for the user.

However, native applications do also have some drawbacks. The most prominent is the number of different operating systems available, which mean that any application created needs to be rewritten multiple times in different languages, to ensure that it can target all devices. This is a huge investment of time and resources, especially as some platforms do not have a large user base (and therefore this effort would potentially be wasted). Native applications must also be downloaded onto the user's device, which requires a commitment from the user, and their on-going desire to keep the application on their phone. Mobile phone users can be fickle, and delete the application at any time for any number of reasons.

Responsive Web Application

A responsive web application is a website that can function both on desktop devices, and mobile devices by scaling the elements on display. They are incredibly versatile because they run in a web browser, which means that they target all possible devices without the need to rewrite the code base in several languages (some tweaks for certain browsers may be required, but this is usually a small amount of work). They are written in the default web languages of HTML, CSS and JavaScript, and the back end can be whichever language the developers are most comfortable with, which makes it very easy for developers of any skill level to work on them. Another advantage of them being hosted on a server online is that it becomes very easy to release updates, because they are instantaneous, and the users do not have to download anything.

However, the Internet is a large place, and without a centralised place to advertise the application, it is possible it will never be discovered by many potential users. Alongside this, web applications require a constant Internet connection to access them, which could be a problem for users that do not have a large data allowance on their phone.

3.2.2 Back End Tools

In this section several well known back end frameworks utilising different programming languages are discussed, with the advantages and disadvantages of each identified.

The Zend Framework (PHP)

The Zend Framework¹ is an open source MVC framework for developing web applications using PHP. It has been around for a long time, and therefore has extensive documentation, and well defined standards and guidelines. This helps all developers using Zend to be able to instantly recognise and understand what specific parts of code are doing. It is a fully object oriented framework, which means that all classes can be extended and an inheritance model can be utilised.

The drawbacks of Zend are that it is very bloated, and can be a little slow, but the reason for this is the huge number of convenience classes that are provided by default (including form validation, user authentication, and many more), which can be removed as necessary to increase performance. In addition, this modularity means that Zend can easily be combined with other libraries, so further features can easily be added.

Ruby on Rails?

Ruby on Rails² is an open source web application framework written in Ruby that implements the MVC framework. The advantage of Ruby code is that it is very readable and mostly self-documenting, which saves developers time whilst programming. However, this can also lead to laziness, and lack of comments, with developers assuming that what they have one is obvious. The modular design of Ruby on rails results in faster development of applications and flexibility, and there is a vast collection of open source libraries (known as gems) available within the Rails continuity.

The negatives of Ruby on rails is that it is difficult to find good documentation for it, and it is more resource intensive than some of the other frameworks discussed, making it slower to boot, and slower to run. In addition to this, Ruby is the only language of those discussed, that I do not personally know, which would have slowed down the initial development process by a large amount, and the intricacies of the framework would most likely not have been utilised effectively.

Javascript with Node.js

Node.js³ is a JavaScript runtime which uses an event-driven, non-blocking I/O model, and is very lightweight and efficient. The advantages of using Node.js is that it is quick and easy to set up a basic server, and it is extremely popular, which means there is a huge amount of support available. This includes Node.js' package ecosystem, *npm*, which is the largest ecosystem of open source libraries in the world. It also means that the entire code base would be written in JavaScript, meaning external developers would only be required to know one language.

However, Node.js is not without its downfalls. These being that it does not scale well to large applications, and quickly becomes confusing and difficult to manage. Along with this, there is no separate of model and controller, which means database internals "leak" out into applications.

¹<http://framework.zend.com/>

²<http://rubyonrails.org/>

³<https://nodejs.org/en/>

3.2.3 Front End Tools

After deciding that the project would be a responsive web-application, the language choice was obvious: HTML, CSS and JavaScript. However, consideration was still necessary for the framework that would be used to create the interface.

Bootstrap

Bootstrap⁴ is a very popular front end design framework produced by Twitter. It is fully responsive and scales easily and efficiently to a multitude of devices, including phones, tablets, and desktops. Due to its popularity, there is a huge amount of support online, as well as extensive documentation provided by Twitter themselves. These things, combined with its simple class names, make it extremely easy for beginners to pick it up, which is an advantage if external developers have never used it before. It can also be customised to only load the components that are required, which helps to reduce the overall size.

One of the biggest advantages of Bootstrap, its huge user base, had proven to also be one of its biggest downfalls. Due to the quantity of websites now using Bootstrap, a large of websites look extremely similar, which detracts users and prevents them from standing out amongst the crowd. Many developers are specifically recommending to not use Bootstrap for this very reason[9], and thus the inclusion of Bootstrap in this project would require thought as to how to make the design stand out.

Foundation

The Foundation Framework⁵ is, similar to Bootstrap, a fully responsive front end design framework. Unlike Bootstrap, and most other front end design frameworks, Foundation is “mobile-first”: which means that everything is responsive by default, and assumes you are developing for mobile. This is useful for mobile-only applications, but it means that applications that also target desktops require more work to implement. As a result of this mobile-first approach, the grid system in Foundation is much more fleshed out than in other frameworks, and has much more functionality. Foundation also has a collection of built-in extra tools, such as *Abide*, which can be used for simple form validation.

However, Foundation provides far fewer themes than Bootstrap, and due to its smaller user base, there is a lot less support available from the community. In addition to this, the majority of the documentation provided is in video format, which makes finding information quickly more troublesome. Finally, Foundation is not supported by certain older browsers (like Internet Explorer 8), which restricts certain users from using the site.

Semantic

Semantic⁶ is the final front end design framework that was investigated, and is the newest of the three. The main advantage of semantic is its concise HTML and how classes use syntax from natural language, which makes writing code much more user friendly. It also extends the majority of interface elements through intuitive JavaScript “phrases”, which can trigger different behaviours on those elements.

The disadvantages are that it is not as well known, and therefore has a far smaller user base than either Bootstrap or Foundation, which means the only real support comes from the documentation that has been provided (which, whilst good, isn’t fully comprehensive). This also means that an external developer is less likely to know how to use it, and they may find it difficult to pick up.

⁴<http://getbootstrap.com/>

⁵<http://foundation.zurb.com/>

⁶<http://semantic-ui.com/>

4 System Specification

In this section, the functional and non-functional requirements of the system have been outlined. These were obtained by looking through the design specification that was provided at the start of the project, and were agreed upon by both parties.

4.1 Functional Requirements

1. The user should be able to search by geographic region and discover routes for that region.
2. The user should be able to contribute routes.
 - 2.1. Only the creating user should be able to modify these routes
 - 2.2. The user can make the route private
3. The user should be able to interact socially with the route, including:
 - 3.1. Commenting on public routes
 - 3.2. Recommending similar routes
 - 3.3. Sharing routes to external social media websites
4. Users should be able to create an account with basic information
5. There should be administrative users who have extra functionality, including:
 - 5.1. Deleting users
 - 5.2. Updating users
 - 5.3. Creating users
 - 5.4. Deleting routes
 - 5.5. Deleting comments
 - 5.6. Making announcements
 - 5.7. Making backups in a standard, free and open format
 - 5.8. De-authorizing active sessions
 - 5.9. Locking the site and preventing access
6. Users should be able to export their routes
7. Users should be able to make a copy of other user's routes and edit them
8. There should be a route editor component which allows the users to construct a route
9. Users should be able to log into their account and:
 - 9.1. Update personal information
 - 9.2. Access and edit their submitted routes

4.2 Non-Functional Requirements

Accessibility

The proposed system is to be made available entirely on-line, allowing anyone with Internet access to use the system. As the application will be web-based, users are not required to download anything before using it, which will make it more accessible, and easier to get started with the application. The only potential issue with a web-based application is if the server goes down, or if the domain expires. The server going down does not, unfortunately, have a solution, but keeping the domain should be trivial.

Usability and Operability

The project should be designed in such a way that users ranging from a low level of skill, to a high level of skill should be able to use it with little prior knowledge. The project will be developed as a fully-responsive web application, meaning mobile devices will be fully supported.

Maintainability & Documentation

The system must be well documented allowing for easy maintenance by an external developer. This includes both an easy to understand code structure, as well as commented code (specifically using PHPDoc, and a similar style in the JavaScript code), which should be kept as modular as possible.

Quality

As this system is to be used externally, and will be a representation of both myself and the client, there are several quality concerns that must be addressed. The system must be built so that it is robust, and works as the user expects, and contains as few bugs as possible. Any bugs that are identified should be reportable to the maintainer, and be fixed as soon as possible. The code must also be of a high quality, and therefore will be written in a modular way, with useful comments provided to highlight the purpose of each function, and illustrate any particularly complex code.

Resource Requirements and Constraints

As this system is aimed at users with a mixture of skill levels, no assumptions can be made on the level of hardware that the users will possess. For this reason, the system will be designed to use as few resources as possible. Fortunately, due to being a web-based system, the load of the system will be fairly minimal, as it is mostly loading JavaScript and HTML5. The only true computation takes place on the server, and thus would not be a concern for the user.

The loading and saving of files potentially causes a problem, but only if the user has very little hard drive space, and attempts to save an extremely large file. This is, however, unlikely, as even very large routes will have a relatively small file size.

The final concern is internet bandwidth which, whilst not a problem on desktops, will be a problem for mobile phones. This is why the amount of data sent to the user when they are navigating a route will be kept to a minimum, so that they do not use up their data allowance (or drain their battery).

Cross Platform Compatibility

Due to the project being a web-based system, it is difficult for it not to be cross platform compatible. The only real concern is cross-browser compatibility, so it is important that the system is tested on different browsers.

Security

Security is a concern for this project, as the users will be able to create accounts with the system, and therefore their data will need to be stored. This data will be stored in compliance with the Data Protection Act, and all passwords will be encrypted.

Disaster Recovery

The administrator should be able to take backups of the site in a standard, free and open format. They should also be able to de-authorize active sessions, and lock the website to prevent access. As far as the code base itself, the project will be stored both on the server, and in a Git repository, allowing for recovery if any problems occur.

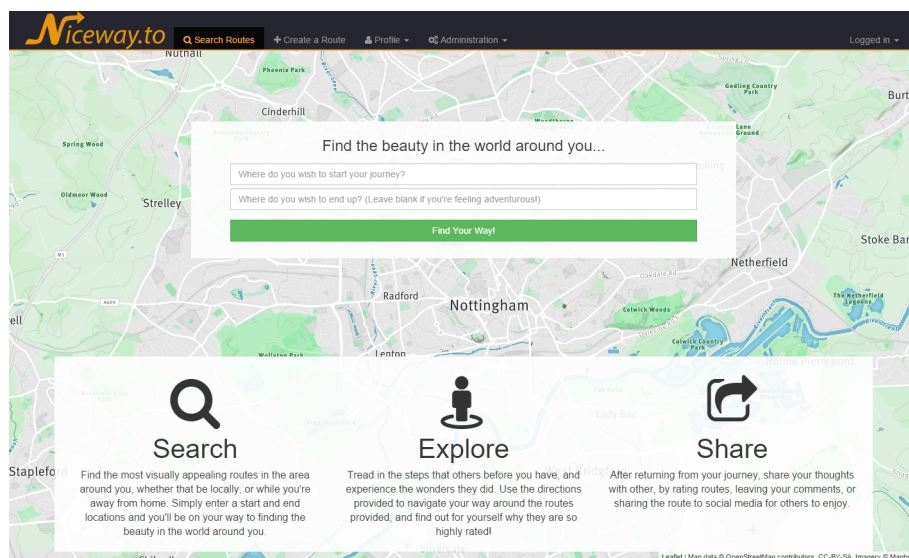
5 System Designs

In this section, all of the design aspects of this system have been detailed and justified. This includes the design of the user interface itself, the navigation and expected user path through the application, and the internal design of the application.

5.1 User Interface Design

In this section, the interface for each of the main pages of the application have been displayed, along with justifications for why they were designed the way they were. Before any work was completed on the project, designs for each of these pages were produced, and shared with the client. The finale designs were then based on his feedback, and the combination of the best features from all the designs produced. These initial designs can be found in [appendix A](#) and are referenced throughout this section.

Route Discovery Page/Landing Page



Why it is good

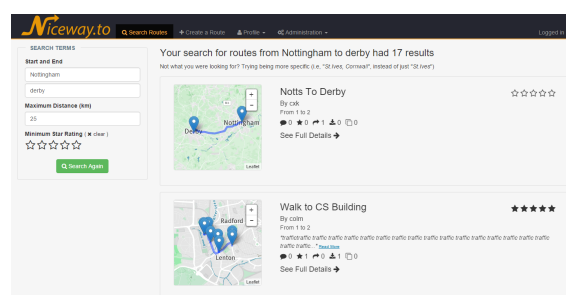
What was taken from each of the designs in the appendix

How it addresses the problem

Why it is designed the way it is

What differences there are to the designs

Route Listing Page



Why it is good

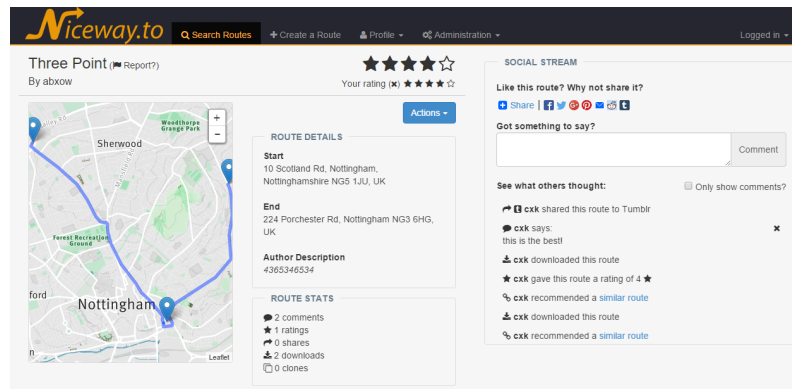
What was taken from each of the designs in the appendix

How it addresses the problem

Why it is designed the way it is

What differences there are to the designs

Route Detail Page



Why it is good

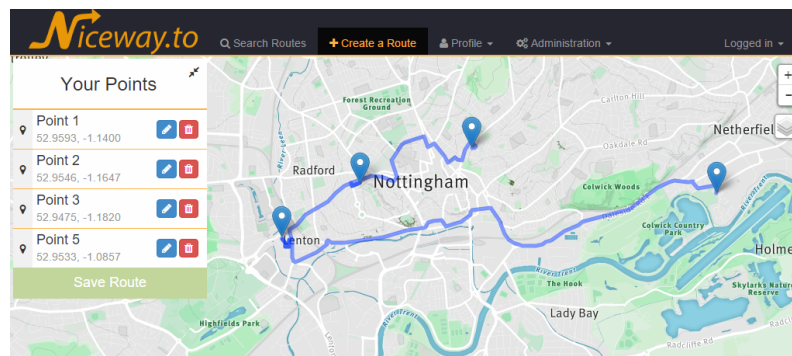
What was taken from each of the designs in the appendix

How it addresses the problem

Why it is designed the way it is

What differences there are to the designs

Route Creation Page



Why it is good

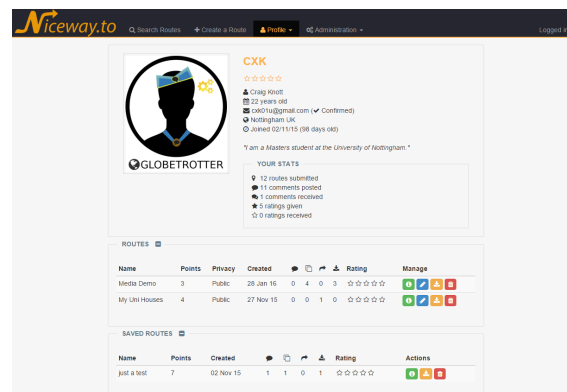
What was taken from each of the designs in the appendix

How it addresses the problem

Why it is designed the way it is

What differences there are to the designs main client feedback was more social - so implemented the social stream to emphasize

My Account Page



Why it is good

What was taken from each of the designs in the appendix

How it addresses the problem

Why it is designed the way it is

What differences there are to the designs

Mention the magic number seven / white space is not your enemy stuff White Space is Not Your Enemy: [8]

The magical number seven, plus or minus two: [17] Could I have the menu please? An eye tracking study of design conventions [16] - how navigation and elements on the page generally start on the left because that's where people (in western culture at least) will look first Colour appeal in website design within and across cultures: A multi-method evaluation [6] - how colours have been used to group actions - green is pos, red is neg Interface design technique to simplify and declutter your interfaces [7] - icons, placeholders, controls on demand, hovers and modals Satisfiers and Dissatisfiers: A Two-Factor Model for Website Design and Evaluation [30] - maybe this too...

5.1.1 Heuristic Evaluation of the Interface

In this section, the user interface is evaluated using several key metrics. These include: the general purpose usability heuristics identified by Jakob Nielsen[19], the golden rules of interface design identified by Ben Schneiderman[25], and some heuristics specifically for the design of interfaces on mobiles device, identified by Nadav Savio[24]. The purpose of this section is to highlight how the interface conforms to these metrics, and why they are important within the context of the application.

JN10: Visibility of system status

JN10: Match between system and the real world

JN10: User control and freedom

JN10: Consistency and standards

JN10: Error prevention

JN10: Recognition rather than recall

JN10: Flexibility and efficiency of use

JN10: Aesthetic and minimalist design

JN10: Help users recognize, diagnose, and recover from errors

JN10: Help and documentation

BS8: Strive for consistency.

BS8: Cater to universal usability.

BS8: Offer informative feedback.

BS8: Design dialogs to yield closure.

BS8: Prevent errors.

BS8: Permit easy reversal of actions.

BS8: Support internal locus of control.

BS8: Reduce short-term memory load.

MH10: All mobile interactions are user-driven.

MH10: New mobile experiences compete with legacy user models.

MH10: Ease of use is paramount.

MH10: Calm technology will be valued over constant disruptions.

MH10: The device as continuous companion opens the realm for mobile experiences of different intensities and durations.

MH10: Mobile interactions can extend beyond the device.

MH10: Mobile interactions are often small steps in part of larger user goals.

MH10: Peer-to-peer is the most trusted form of mobile marketing.

MH10: With GPS on the near horizon, the mobile phone will be able to provide services that redefine our social networks and the places we inhabit.

MH10: Mobile phones will not be limited to the processing capabilities of the device.

5.2 Navigation/Control Flow Design

general path for non user - landing page (want to search, so box is very visible, like google), then results (clearly laid out results with ability to research if mistakes), and then detail page (display everything about the route, but ability to look deeper if user so wishes)

general path for expert - login in, look at my account, check out new social interactions on their routes, look at friends routes, create a new route, update skins

- The generally expected path for a user to take through the system + picture
- include path for both types of users
- Explain how design facilitates this - navigation for random access (except RLP)

5.3 Internal Design

- Models/Controller/Views with flow of data (plus ajax arc) (Mention client server stuff (probs in that diagram))
- Languages?
- See image from last year diss

6 Software Implementation

In this section, the actual implementation of the software has been detailed, including: what tools were used in the implementation, how the software was implemented, and any issues that were encountered during the implementation process.

- Screenshots of initial designs + justifications
- Screenshots of final designs + justifications + reasons for changes
- Screenshots of actual final system + reasons for changes

6.1 Key Implementation Decisions

- From the background research section, list all the technology I chose to use and why

6.2 Implementation Methodology

- To help manage the implementation of such a large piece of software, the adoption of some methodology was necessary. It was decided that the best methodology would be an agile one, with heavy use of Kanban, using the tips laid out by Henrik Kniberg [11]. In order to accomplish this, at the beginning of the implementation stage, after the requirements specification had been detailed, the entire project was split into user stories. Each of these stories detailed a specific action that a user of the system would be able to accomplish, along with how long it should take to implement, how important it was, and a way of testing its completion. These stories were then organised onto a digital Kanban Board, using a service called Trello⁷.

Each week, a set of tasks would be selected to be worked on for that week. The amount of tasks selected would be dependent on how much was completed, on average, in the weeks before, so that reasonable estimates could be made (obviously excluding the first few weeks). This ensured a decent portion of work was being completed per week, and that progress was constant. During the week, tasks would be selected from the available pool, prioritising those that were prerequisites of others, or had a high importance, and would then be worked on until completion. After the completion of a task, a new task would be selected, and work would begin on this. This was an extremely effective method of managing the implementation, as any small tasks that were necessary could be added to the board, and there was an assurance they would eventually be completed, and nothing would be overlooked. It has also been shown that it is much easier to reach goals if they have been written down [29], which a Kanban Board was the perfect tool for.

Also mention weekly meetings with max and use of Gantt chart. Also mention this is what I did at work and in my last diss and found it the best way to work for me?

6.3 Implementation of System Components

- Potentially don't need this
- Do last, look at last year's diss

⁷<http://www.trello.com>

6.4 Problems Encountered

- Look through problem log document and pick out key things, especially those with lessons
- What happened / what this affected / how the project was affected / what I would do differently / why it happened

7 Testing of the Project

7.1 Functional Testing

- In this section, each of the functional requirements laid out in section 4.1 have been evaluated in turn, to ensure the system meets them. Knowledge of the inner workings of the system is not actually necessary to understand these tests, as they simply check whether functionality is present, and are not concerned as to how the system actually implements it (this is known as black box testing [4]). A complete listing of all the tests conducted, and their results, can be found in appendix ??.

some interesting thing to point out... ?

7.2 Non-Functional Testing

- Look at non-functional requirements and talk about if they were met

8 Evaluation of the Project

8.1 User Feedback Testing

An important part of evaluating the usability and accessibility of any software system is to have real world users attempt to actually use it - The usability engineering life cycle [18]

- user feedback / questionnaire / focus group / test users? + their feedback
- the aim of these tests is to find **usability problems**
- RITE method for discovering bugs

8.2 Successes and Limitations of the Project

- As a result of the test...
- x was good
- y was bad

9 External Aspect

- Very similar to proposal
- as well as explicitly addresses how your project fulfilled (or not) its original intentions with regard to its ‘external aspect’.
- maybe put this section AFTER evaluation? (or just combine the two...?)

10 Further Work

- 2-4 bigs things that I would do next time (either changing something I did, or adding/removing something)
- increased scenicness between points (atm it connect points with the shortest ath, future shoudl do most scenic ;))

11 Summary & Personal Evaluation

- Personally, I feel as though the project was a /success|failure/
- I felt as though I /failed to rise|rose/ to the challenge
- One of the areas I feel as though was weaker within the project
- If I could work on this project again

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A Appendix