

# "VisualNation - An Online Interactive Visualisation Experience"



Interactive Multimedia Design 2014

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## **Introduction**

'Visual Nation' is a project designed to provide a solution of developing an interactive and info graphic website to display statistics of Northern Ireland. This aim can be broken down in to objectives. The website provides a map that allows users to zoom and explore their area and then select their area to see statistics displayed in chart format. The entire process of this project has seen the implementation of focused research, design and development practices and testing and evaluation methods, through the use of the waterfall methodology.

This report is designed to provide an in-depth look in to the journey of this project, from the initial concept and design to the implementation, testing and final product. The journey of this project started many months ago with an initial idea and has progressed from there to provide a working solution to satisfy the brief. The report will begin with a look at how the initial brief and problem was approached and how concepts and initial ideas were developed. From there the report will then document the process of defining a suitable concept and how this evolved to the design process and, following that, the implementation process. Following this will be an in-depth look at the testing and evaluation phase including a personal reflection on the entire project.

# **Concept Definition and Testing**

## **Idea Generation**

Generating an initial idea is perhaps the first major problem to overcome in the project and this was dealt with through brainstorming and generating concept definitions.

Understanding the initial concept is the first step to identifying a suitable concept and this was done through the use of idea generation workshops and lectures.

The objective of the project is to create a suitable multimedia application whether this is a website, mobile app or other medium, to showcase various types of web development skills and languages. With a broad spectrum of possibilities it can be hard to narrow ideas to find a suitable solution, so the help of guidance is important here and previous examples of work provide a helpful starting point. Idea generation led to concept definition statements which consist of 3 possible ideas:

1. An interactive website to show various points of interest around Northern Ireland.
2. A map based website to portray vital demographics and statistics about Northern Ireland and lower geographical levels.
3. An interactive website to store projects and tasks for users to help manage projects.

Through guidance from university staff the most suitable idea was chosen, and this was the second idea of a map based statistic website.

### Initial Idea

This idea stems from experience working with statistics and info graphics and notching a niche for representing comprehensive statistics in a simple and useable format. NINIS - Northern Ireland Neighbourhood Information Service - is responsible for hosting and processing the official statistics of Northern Ireland, including the Census 2011 results, and they do so in large complex tables.

What NINIS provide is a detailed table of statistics, broken down into categories and then into various geographical levels, making accessing simple information, such as population, a lengthy task. Whilst their content is more than suitable for its purpose, there is potential for that content to be viewed in another format. The idea of 'Visual Nation' is to provide a

platform for professionals and the general public to view simple information fast and also connect with visual learners or those who struggle to interpret data in text form. This project is designed to be a companion to NINIS, whilst maintaining a separate identity as any information being used is open source.

### Concept Definition

The idea is to create an interactive website that portrays simple but important statistics about Northern Ireland in a chart format. The website will consist of a map of Northern Ireland, which will allow users to explore their neighbourhood visually. The map is the main focus of the site but will be supported with graphics, such as interactive charts, and text to explain the statistics. This website is aimed at those who are interested in learning about their neighbourhood in a quick and visual way without having to browse through comprehensive tables of information. This type of resource would be useful for professionals, schools and also the general public. The structure of the website is very simple with a homepage and search page to carry out the main functionality of searching, and supporting pages to deal with any other functionality necessary for the website.

### **Requirements Specification**

Defining the requirements for the project will give direction and help set a clear and defined theme for the project. Before stating the requirements it is important to assess the project drivers to determine the purpose of the project.

### Project Drivers

- Background: The project is the chosen solution for a final year major project and has been chosen as a satisfactory solution to the brief. The website is ‘Visual Nation’ and its context is an online learning experience that portrays information and statistics about Northern Ireland.
- Goal of the Project: The principal service goal of this project is to provide a user-friendly and engaging website to portray basic and fundamental information about NI.
- Stakeholders: Identifying the stakeholders allows the user requirements to be tailored, focused and achievable. The main stakeholders involved are the hands-on users who

will use the website on a day-to-day basis. As there is no specific client to work for the user requirements will be focused on the customer base and their priorities and expectations.

- User Base Profile: This will consist of the general public as this website can be interpreted by anyone. Most likely the website will be used by schools, the public sector and researchers. Their typical environment is learning and gathering information so they would use this tool as a resource or hub of information. This means the website should cater for all levels of understanding and abilities.
- Collecting User Information: Collating the demographic needs to determine my user base can be done in many ways. Face to face interviews can be carried out or questionnaires can be provided. A small sample of people, in a range of ages and occupations, were asked a few questions to aid understanding of the target market.

### **What would you expect/want from an interactive info graphic website?**

1. "It should be easy to use and easy to understand..."
2. "Interesting. Normally I wouldn't be interested in this kind of information but if it was interesting and fun then I would definitely use it."
3. "I would want to be able to explore my area and find out things that I normally wouldn't know."
4. "Quick, simple and fun. That's how you will keep kids engaged."

### **What features would you want or not want?**

1. "You should be able to zoom in and roam around the map."
2. "See symbols and landmarks that are easy to recognise. Keep the info graphics simple but informative."
3. "Maybe interaction with Facebook or Twitter would be beneficial. You could check-in from a location and then find out information or be able to share information."

### **Are you a visual learner and would you appreciate info graphics?**

1. "Yes, I am definitely a visual learner and this would be more interesting than a complicated table."
2. "I use information on NI for my work so infographics would help me save time and allow me to work quicker."

3. "I am a kinaesthetic learner so a hands on approach is more beneficial to me. If this info graphics were interactive that would engage me."

In summary the user base is wide but focused on schools and professionals. As they are all different types of learners from different types of backgrounds, it is important to appeal for all.

### Project Constraints

There are some points to note that may bring issues to the project and determining these now will help to help eliminate risk.

- Time: This can be a major issue in a project timeline. The project is being developed within a small time frame to complete the entire project but this can be remedied with efficient planning and time management.
- Knowledge: The functionality of the project can only be built using languages and techniques that are known and experienced by the developer. This does, however, eliminate some techniques and features.
- User Experience: The functionality is also restricted to the knowledge the user has. It would be impractical to create a highly technical and completed website if none of the user base can use it.
- Existing Solution: At the moment there is only 1 existing website to display statistical information. This site, however, has a very high level and technical user base who are frequent users. 'Visual Nations' target market is low level and, therefore, there is no existing solution for this market.

In Summary the finished product should be designed with a **realistic time frame** in mind and with consideration to the **knowledge available**. Other things to consider are what **competition** is already available and **how to make the product unique**.

## Functional Requirements

These are the requirements of the website and system that depend on the behaviour of the website.

- *It should search the database for information.*

The user should be able to input a town, city or area and the database should be able to draw relevant information on this area.

- *Be accessible to cater for all needs and capabilities, including useable with screen readers and other accessibility tools.*

This function includes the ability to change fonts, colours and other elements.

- *Should respond and load data quickly*

This is imperative to keep users attention and engage them when using the website. With a fast and reactive website users attention, especially younger children, will not wander and they will be able to get more out of the site.

- *Be useable in all major HTML 5 supported browsers.*

As the web is evolving it is important to stay up to date. HTML5 and CSS3 should be used where applicable.

- *Link to an appropriate MySQL database of relevant information using PHP.*

A MySQL database is imperative to store the relevant information for each area.

- *Should accept user input events including text/keyboard and mouse events through languages such as JavaScript and jQuery.*

It is important that the website reacts to the users input and carries out functions based on this input.

- *The code and structure of the website should meet web standard certifications*

The entire code throughout the website should meet W3C standards and be valid.

- *The website must display, clearly, statistical information that is relevant in an interactive format.*

This is the fundamental function of the website as it is important that the information is clearly displayed. This should be done using interactive methods.

- *It should be incorporated with a mapping system to allow users to view their current area and display the corresponding information for that area within an interactive map.*

Geo-location services are needed to ease the use of service. By enabling this function users will need less time to locate their area. In summary the system should be **quick** in response and **display information clearly**. It should link to **relevant** information and **work in a range of browsers**.

### Non-functional Requirements

Non-functional requirements are those that determine the ease of use of the functional requirements.

- *The website should be accessible with options to change fonts, sizes and colours.*

Despite mentioning this before this also falls under the non-functional category. As this website will be providing a service to the public it needs to cater for all people and all needs, whether in my targeted user base or not. As a functional requirement accessibility means the function of changing fonts and colours, whereas as a non-functional requirement it means allowing to reach all types of users and capabilities.

- *It should be acceptable to meet the required project brief and be of a good quality.*

The website and entire system should be of a respectable quality and should satisfy the brief.

- *It should be fun and engaging with users, especially those of a younger audience.*

As this system can be used as a learning tool it is important that the content of the website is engaging and captures attention. The content should be relaxed, easy to interpret and fun.

- *It should be reliable and always be available when necessary, with as little downtime as possible for maintenance.*

When maintenance is necessary and unavoidable it is acceptable to take the website down for a short period of time to update and fix any problems. Provided the downtime is kept to a minimum.

- *It should be safe and acceptable to be used in work places and schools.*

The website should not have any content unacceptable to be viewed in a workplace or school environment. This will be represented in the simplistic and clean theme and design.

- *Should be of a neutral colour scheme.*

This is an important point to consider. As the nature of this project is about Northern Ireland it is imperative that a neutral colour scheme is used with colours that are not easily identifiable.

- *Be user friendly and easy to use.*

The website should be easy to use and navigate by all ages and capabilities. This will include services such as easy navigation, a site-map and breadcrumbs.

- *Be adaptable to unexpected events and deal with error handling.*

Sometimes unexpected events happen, such as a crash or an unknown page, and the website should be able to deal with this. This will include providing an 'unknown' page or 'We are experiencing technical difficulties' page.

In summary the website should be **user friendly** and **easy to use**, whilst also **engaging**. It should be of a **good quality** and be as **interactive** with the user as possible.

# Paper Prototyping

## What is paper prototyping and why are we using it?

"Paper prototyping is a variation of usability testing where representative users perform realistic tasks by interacting with a paper version of the interface that is manipulated by a person 'playing computer,' who doesn't explain how the interface is intended to work." [1] (2014, [paperprototyping.com](http://paperprototyping.com))

## Initial Design Process

One of the first steps in this process was to write down everything to be included in the site, starting with the functionality of the site, progressing to think about the pages of the site and what should be available on each. The design process has been developed around the functionality to provide the best user experience.

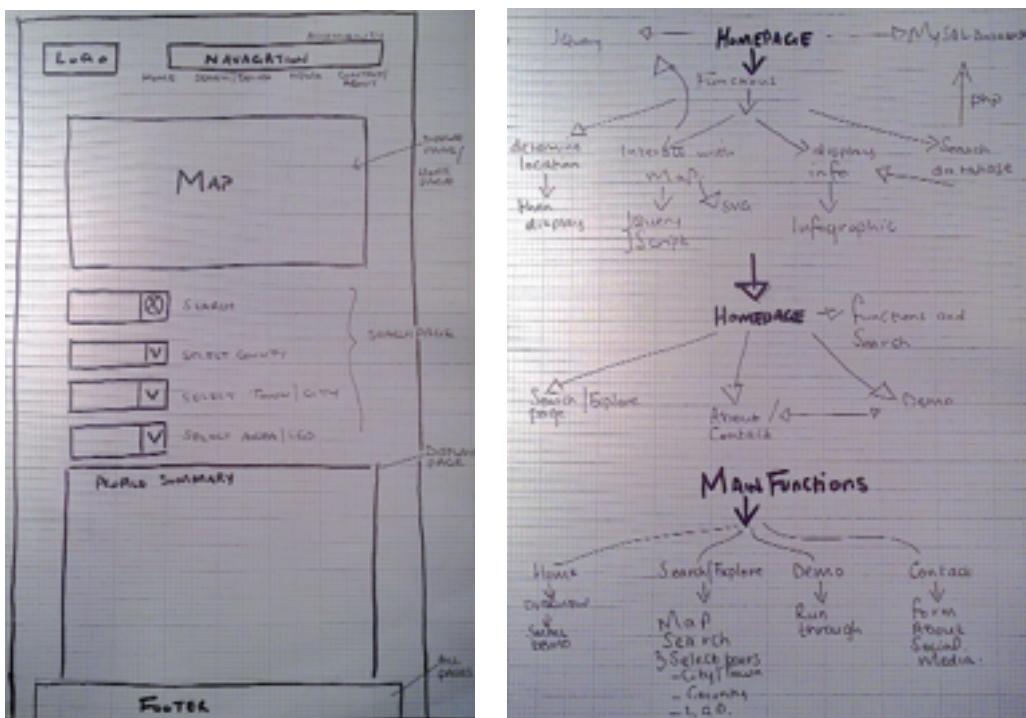


Fig 2.1 Paper Wireframe, Fig 2.2 Paper Hierarchy

The first section of the tree diagram, *fig 2.2*, shows the homepage and its functionality, including 4 of the main functions and how these functions work. The next tier then describes the functionality of the homepage, which will be one of the main features and finally the final tier looks at the pages of the site and what they will provide.

Beginning the design process is shown in figure 2.1, where the website was sketched as if it were a single page site. This helps determine which functions need to go where and how to break the website down and structure it properly. The main function is searching and delivering results, which can be done in many ways. The other main features are navigation, accessibility, search or select functions and displaying the statistics.

Determining the main functionality helped to decide which features belong where on the website. The logo, navigation, accessibility and footer are consistent and will appear on each page of the site. The map will be available on the 'Search' page and a decision was made not to include it on the homepage so to keep the functionality consistent. The statistics, in chart format, will be included in the search page also.

After deciding on the main features that are needed, sketches were made in the form of 6-ups; 6 design solutions of one page. The chosen page to represent in this format was the 'Search' page, focusing on how the search could happen and how the results of the search could be displayed. When sketching there were questions to consider: How will the information be displayed when a user selects a location? Will the map be used here or will text and graphics be used?

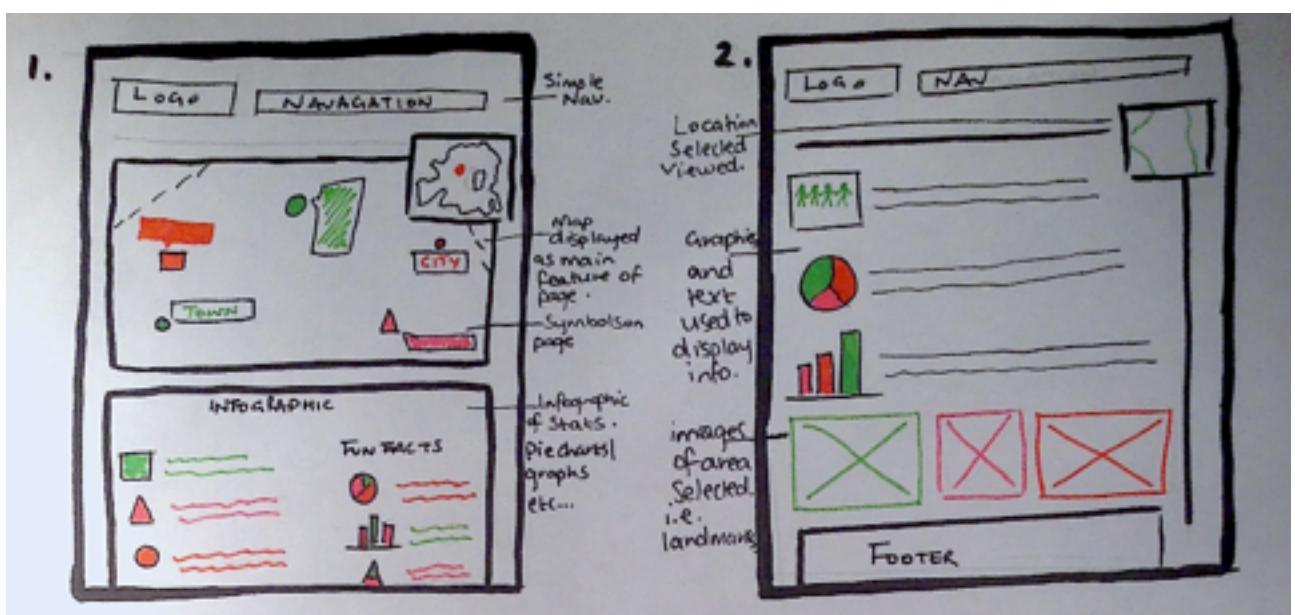


Fig 2.3 Paper Wireframes

1. The first solution, on the left fig 2.3, displays the information through the main map and through an info graphic below it. The map has symbols and points of interest and also shows a larger view of the overall map. This provides a good starting point but the layout may need changing to make it more engaging and interesting.

2. The second solution, on the right fig 2.3, is a more text-based approach. This works with a combination of text, graphics and images to display the information. This is, perhaps, not the best way to display information as this site is aimed at visual learners and the text approach may not work with this attribute.

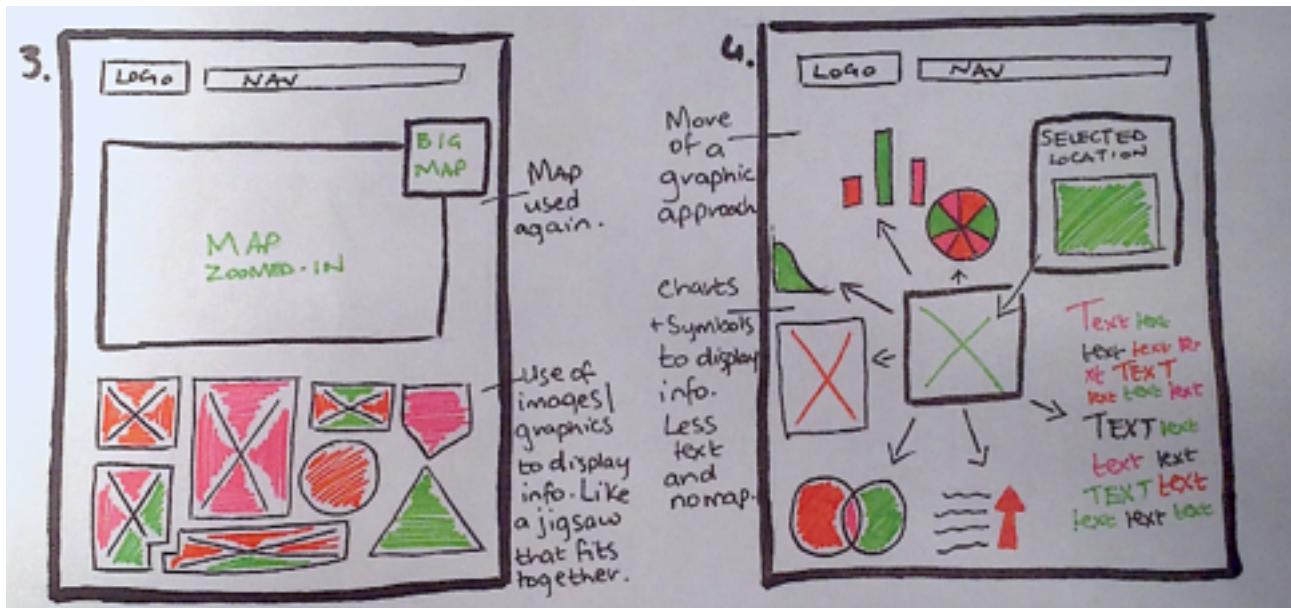


Fig 2.4 Paper Wireframes

3. The third solution, on the left fig 2.4, again uses the map as a main feature and would continue to have symbols and points. This solution would have no text, only graphics or images. Although this site is aimed at visual learners it would be unwise to have no text at all, as this limits the user base.



Fig 2.5 Paper Wireframes

4. The fourth solution, on the right fig 2.4, is using a more graphic approach, again, but it does not have the big map as a main feature. This solution would also benefit from a small bit of text and perhaps the lack of map will be confusing and users would prefer to have a map to reference to.
  
5. The fifth solution, on the left fig 2.5, focuses solely on the map as the only feature. This would involve the points and symbols as before but they would be bigger and more detailed. Like before, that this would benefit from some sort of text feature to allow a simple explanation for each graphic.
  
6. The final sixth solution, on the right fig 2.5, uses a timeline approach to display the information. This idea is useful as it makes the graphics easier to see and process but this idea would benefit greatly from a map.

## 1-Up

A 1-Up, a chosen solution, was developed from the evaluation of the 6 possible solutions. The possible design chosen can be seen below in figure 2.6. It incorporates a simple logo and navigation at the top which will be used across all pages, whilst the accessibility features can be accessed easily at the top also. The map is then easily seen from the top of the main content, but it does not take up the entire page.

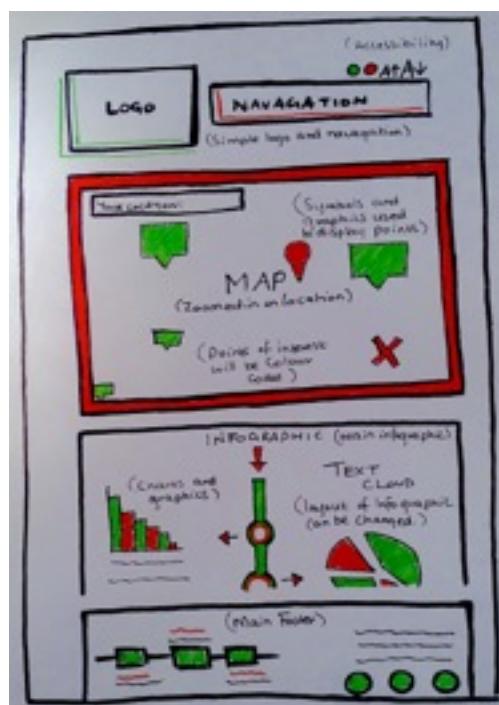


Fig 2.6 Paper Wireframe

After the map the section for the info graphics will be displayed. At the moment a timeline has been incorporated in to this section, although as each location will have different information, this may not be suitable and could complicate the display of the information. A mixture of graphics and text will be useful here, although text will be kept to a minimum and will provide extra details or descriptions to the graphics.

Further prototyping of the search page, and also of the homepage, can be seen in appendix A. The homepage solutions are similar to the search page, but only differ slightly in the layout and a possible final solution can also be seen in Appendix A.

## **Feasibility Testing**

At this point in the process it is useful to evaluate the work already completed and how this affects the feasibility of the project. The concept has been defined and planned, a requirements specification has been compiled and paper prototypes have been developed. Without this planning process the project lacks direction and focus and it will provide a helpful plan to use during the coding process. Now is the time to consider how practical and attainable the project will be.

## **Initial Analysis**

### Aims and Objectives

The aim of this project is to provide an interactive learning experience for the target market. To attain this aim the objectives for the project need to be reached and so the objectives should be assessed to determine if they are achievable, if they pose any risks or problems and whether they need to be changed or altered to suit the project. From the initial design phase the objectives were to continue to research, to create a focused design plan, to then create and code the website and finally test and evaluate the website. All of this ties in to the chosen waterfall methodology.

The first objective is to provide a fully user-friendly website that stores relevant information and consistent and quality content. This objective means the website should successfully link to a database, which is one of the main functional requirements. The database will be searchable and should hold all relevant information that users could want; this objective is

realistic and attainable and is necessary for the project. Operational risks may come with this, such as hackers and threats injected in to the database.

The second objective is to provide a platform that meets the needs of all users and is accessible for all. This is an important objective as the website will have a wide user base and it is important to cater for all users. This objective will overcome problems rather than create any and by identifying this early and risk can be eliminated.

The final main objective is to provide a website that users can interact with. This will include using jQuery and other interactive languages to provide events that will bring the website to life. Currently this objective is the most daunting one as I do not have a detailed plan for the interactive methods I will need. The problems to anticipate are how to interact with the map and how to create the function of searching. Planning and research is necessary to overcome this.

### Strengths and Weaknesses

The strengths of the author lie in coding and website development and have confidence in working with JavaScript/jQuery/PHP. This provides a good base to start and also a useful starting point if it is necessary to learn other similar languages. The authors weakness is in design and CSS coding. As experience is limited in this area there is room for development and learning here but this also gives potential for problems.

### Potential Risks and Problems

There is a potential safety risk when using databases. This could include hackers injecting threats in to the database and allowing access to users information or compromising the information available. Although the database be storing any sensitive data, such as user information, it is still necessary to have a safe and protected database and this will be helpful if the website were to develop and if there is a need to store sensitive information. It is important to ensure a secure database is being used through the use of PHP code and monitor the database frequently.

Another problem previously mentioned is with the skills and experience available in design and CSS coding. A focused work plan is imperative at this point. Communicating with peers and other members of the potential target market will provide opinions to work with

and new and fresh ideas. This strategy should be applied while keeping in mind the functional requirements of the website.

There are other potential problems that may arise, and some may be out of the control of the author. As it is impossible to predict all problems that may arise it is necessary to have a suitable strategy in place so any problems can be quickly and effectively dealt with. This strategy is to evaluate problems and get help if needed, redesign/code if necessary and then reassess. Problems that may be out of the authors control could be, for example, server problems and so this would be dealt with differently, but still in keeping with the same strategy.

## Constraints

### Resources

In some projects the resources available can have a major influence on the end result. In the context of this project, there is no major need for resources. The biggest resource available is knowledge and the knowledge of the help available and this is not a constraint but rather a helpful resource. Other resources include information and statistics but this information is free to use by the public, so it poses no problems. A constraint that may arise is staying in communication with my target market as the targeted user base is so wide and trying to stay in touch with a suitable portion may prove difficult. To overcome this it is important to keep in touch with the user base, through communication methods such as interviews and questionnaires.

### Time

Time in this project is perhaps the biggest constraint and it is imperative to plan and use time effectively.

### Gantt Chart

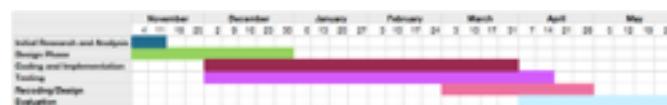


Fig 2.7 Gantt Chart

The gantt chart (Appendix A, figure 2.7) provides a clear vision about the work to do and when it needs to be done by. This is a technique could be used for each stage e.g. in the Fiona Dunbar - B00548156

coding or design stage, to provide more detail about each piece of work to do. By looking at the chart the timescale seems feasible, but there is little room for error. By overlapping some stages at the end of the process there will be more control over the final product and the outcome. As it is important to get feedback, peer group and target market evaluations should be incorporated into the testing stage to always have fresh opinions available.

## Scope

After reviewing the various parts the project feels more approachable. By using time effectively, and using the gantt chart as a guide, tasks and stages of the process should be monitored easily. There may be unplanned problems or risks that arise but the problem solving strategy mentioned above will be used to deal with those problems and how they might affect the project.

## Methodology Selection

Selecting the appropriate methodology can make a huge difference to a project, and so it is important that an informed choice is made when choosing a methodology. There are a number of things to consider before chasing the right one, however. All of the work involved will be timely and will require the use of knowledge, online tutorials, books, and help in lab classes to complete the work. This work should not be costly in any way, expect for time.

Methodologies available include agile, lean, waterfall, prototyping and scrum. The methodology chosen for this project is waterfall and this is because it has a structured and flowing pace. As this is a small project, using agile might take too much time in each stage and this project would be more suited to waterfall. Testing and evaluation is a huge part of any project but for this project it may be more suitable to have an initial prototype and then test, re-code or re-design as needed, which gives structure and allows goals to be ticked off as they are finished.

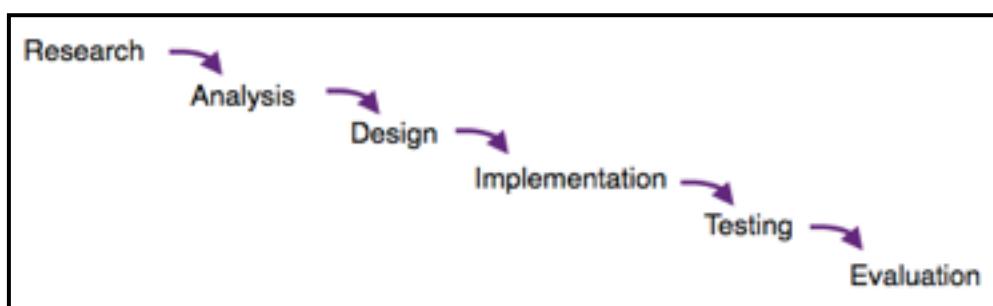


Fig 2.8 Waterfall Methodology

## Time Plan

Initial research and Analysis - October to beginning of November

Design Phase - November to end of December

Coding and Implementation - November/December to March

Testing (ongoing) - March to April

Re-coding/design - March to April

Evaluation - April.

## Design

### Initial System Design

Designing the system with functionality in mind is imperative. The main basis of the project is to provide an interactive informative platform displaying statistics and info-graphics. A lot of the functionality of the website is within the front-end interaction that comes from user input and interaction and also from the database. The system should be robust enough to support a database and the front end interaction.

### Model View Controlled Perspective

Using the model view controller perspective a better understanding of how the site will work can be gained. The '**Model**', consisting of a PHPMyAdmin **database** will respond to **requests** made from the '**Controller**', i.e the browser, such as **keyboard or mouse events**. This will then be displayed in the '**View**', consisting of the **HTML, CSS** and other client side scripts and languages. Model-View-Controlled Perspective in the context of 'Visual Nation':

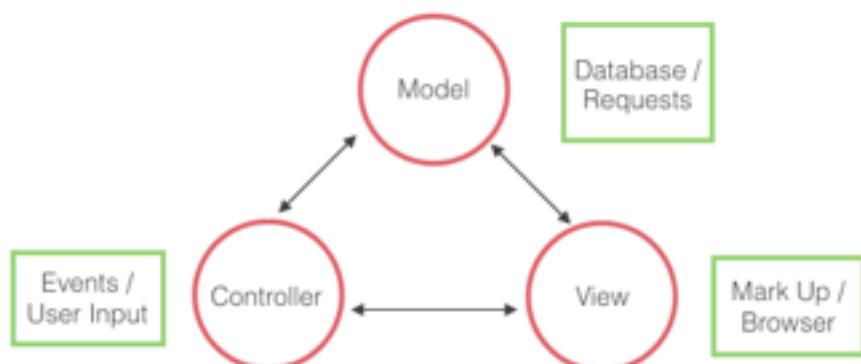


Fig 3.1 Model View Controller

The user of the website will be able to interact with various components of the site. This includes viewing statistics or interacting with the map. When a user clicks on a specific town or statistic this will trigger a piece of script to get the corresponding information from the database, using PHP or a javascript function. The controller will receive the user request through a method such as HTTP \$\_GET or \$\_POST and this will then call the model to search the database for the appropriate statistics, based on the type specified in the function. The controller will then use an appropriate method in the view, whether full screen, mobile or tablet, to display the statistic on the map.

There is another way to look at the infrastructure of the website and this is through the use of the Client-Server Model. Through this model we can identify how the network and system will work.

The '**Client**' side will consist of many things:

- Markup - HTML, CSS/CSS3 for display and viewing the content
- Scripting - JavaScript, jQuery and d3.js for the interaction
- Mapping - MapBox, SVG and Canvas for formatting the map
- Document Object Model
- Display - Desktop and mobile

The '**Internet**' will work to provide the information from the server side and display it. This will be triggered through user input like keyboard and mouse events.

The '**Server**' side will store:

- Database - PHPMyAdmin database to store all data and information
- JSON - Data can be converted to JSON if needed for easy interpretation of data
- Script - PHP/MySQL script to call data and display in browser

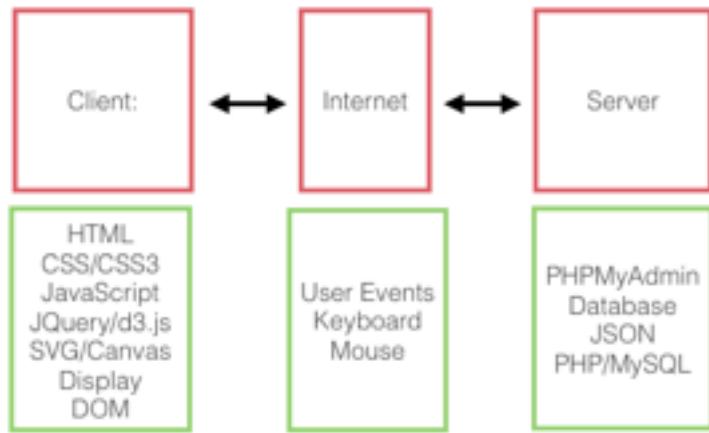


Fig 3.2 Client Server Model

## Database

The database will be one of the main components of the site as it will store the information and statistics. Despite having to store a large amount of information the database initially consisted of two tables, one to store the information for each of the town/city/place. There was another table to store other ‘random fact’ information and this was because the information was not consistent with the other towns and places information so it was best not to confuse the two. Each table had a field for the name of the place, the area it belongs to and the coordinates of that place so it could be located on the map. Then the statistics for that place would have been in separate fields of the table and each will be called through a different JavaScript function.

Database Name: Statistics

Tables: TownStatistics, RandomStatistics

Columns: Name, Coordinates, Area, Statistics 1, Statistics 2, Statistics 3, Statistic, Type

## Technologies

Now the architecture and infrastructure of the website is defined the technologies needed for each major component of the website can be identified. As these components will make up the main functionality of the website, it is important to have the appropriate technologies to build and support them.

### Interactive Map:

As one of the most important features of the project it is important to find the most suitable technology for this project. Initially, the immediate thought for a map service would be

Google Maps API or other services including Bing Maps and Yahoo! Maps. Any of these would be useful as all of the mapping technology is done for you and it would be easy to incorporate in to the website. However these services can have a hefty cost and also usage limits, which can create many problems. OpenStreetMap is a free open source mapping software, which allows anyone to use a map and alter it to suit your needs and it has been discovered through research. It has a more attractive user interface than the likes of Google Maps, with a simple theme and less busy maps, which can be off-putting for a user.

Another advantage of using OpenStreetMap is the partnership between it and MapBox. MapBox is a software that allows you to customise your maps and use them as you need, for a small yearly fee and it uses open source libraries with a combination of JavaScript and JSON to produce a user-friendly map. In addition to this, the d3.js library is another component that would work well with maps and visualisation as this works with SVG and Canvas. This library could be useful to create a map layer that can lie over the map and customise and add interactive content.

#### Interactive components:

As the website is interactive there will be many animations and events throughout the website and for these components I will use a combination of CSS3 and jQuery. These are easy to use and implement and the files are easy to call and store and easily allow for code re-use.

#### Dynamic data:

The statistics and information for each town/city/place will be called dynamically depending on the user input. The data will be stored in a PHPMyAdmin database and PHP/MySQL will be used to call the data when needed, insert it in to an array and then output it to a JSON file. From the JSON file the data will be called in to the browser and DOM using jQuery and JavaScript. Other technology suitable for this use is Ruby, however experience is limited with this language and at this point in the project it is better to stick to a known language.

#### Design Patterns:

To be efficient with code and time it is useful to use design patterns. This can be incorporated in by reusing code for my header and footer. These components will stay the

same throughout the site and so reusing the code will help to keep the code and design consistent. The technique can also be applied to CSS in the entire site which should stay consistent throughout, although some pages will be slightly different and may need a tailored CSS file.

## Architecture

The initial proposed system architecture:

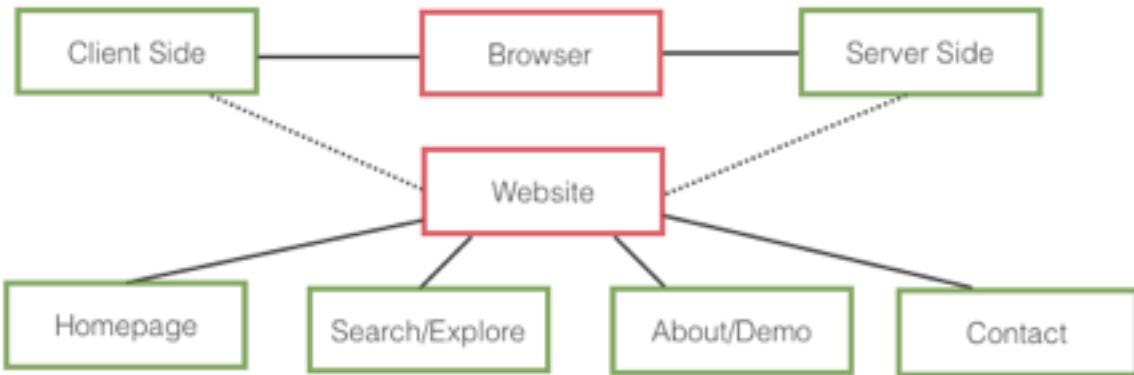


Fig 3.3 System Architecture

## System Design Evolution

The system has evolved from the initial proposed design and this has happened throughout the implementation process.

The various components and technologies described and initially are still very much relevant as not much has changed in the system components. These include:

- A MySQL database to contain information about towns and places and various statistics about each place.
- Various JSON files for each town/place which contains 3 statistics and the corresponding data.
- A combination of AJAX and PHP to call the data from the JSON file and display it in a chart/info-graphic.
- HTML, styled with CSS to make-up the website files.
- An interactive map, sourced from MapBox with its own custom style.
- JavaScript to add interactivity and aid with accessibility.

## Database

A MySQL PHPMyAdmin database is used to store the data needed for towns and places. This structure has evolved into 4 tables, with the possibility of future development. First is a table to display the towns and places and their corresponding details, such as name and coordinates. This table is linked to the other 3 statistic tables which are 'Population', 'Employment' and 'Health'. Each table contains the statistics and the town or place that it corresponds to. The database structure has changed and evolved to allow the best structure and representation of the data. This was necessary to keep the process of calling statistics simple and neat.

### Database Name: Statistics

Tables: Area, Population, Health, Education

Area: Name, Population, Education, Health

Population: Town, Population, Percentage, Remainder

Health: Town, Very Good, Good, Fair, Bad, Very Bad

Education: Town, No Qualifications, Level 1, Level 2, Level 3, Level 4 and Above, Apprenticeship, Other

Education	Health	Population	Area
Town No_Qualifications Level_1 Level_2 Level_3 Level_4_Above Apprenticeship Other	Town Very_Good Good Fair Bad Very_Bad	Town Population Percentage Remainder	Name Population Education Health

Fig 3.4 Database Tables

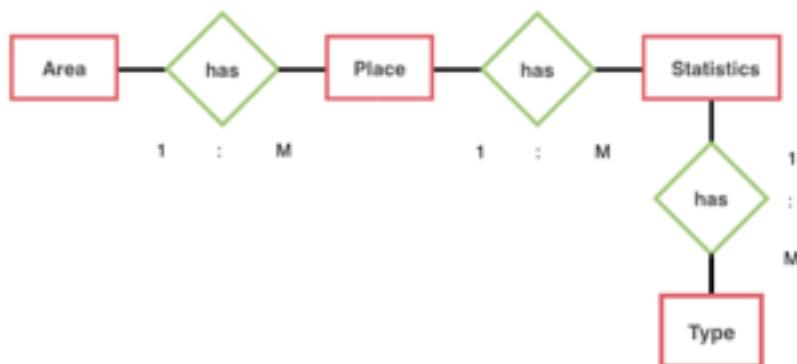


Fig 3.5 Database Schema

## New Technologies

The new technology introduced to the system is Google Charts. This is how the charts are displayed on the website after an area is selected. The database is queried and outputs the results, in the form of JSON, which is then loaded in to the charts.

## Architecture and Software Models:

The architecture of the site has evolved slightly, so as to reflect the functionality. The ‘Search’ page has been renamed to ‘Explore’ as the search functionality does not work effectively so explore represents the functionality of the page better. The new architecture is represented like so:

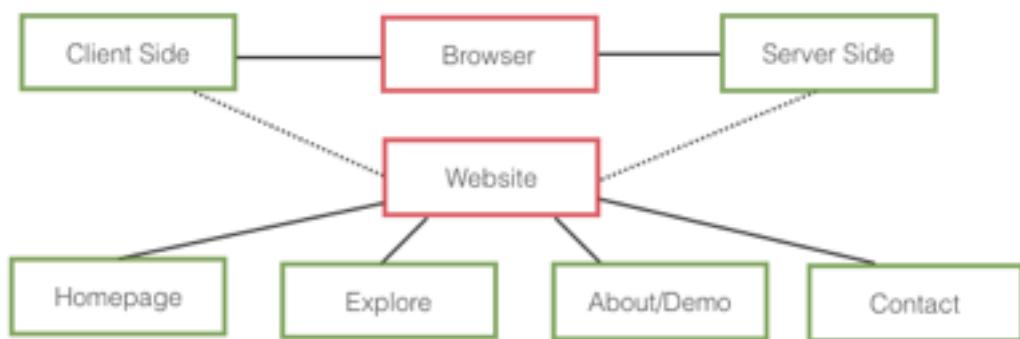


Fig 3.6 System Architecture

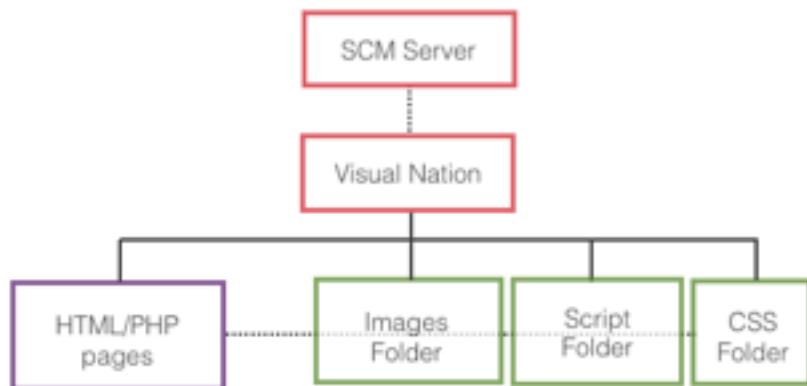


Fig 3.7 System Architecture

The client server model for VisualNation has been altered slightly to show which technologies, languages and components will belong where on the server. The main change is the introduction of Google Charts on to the client side.

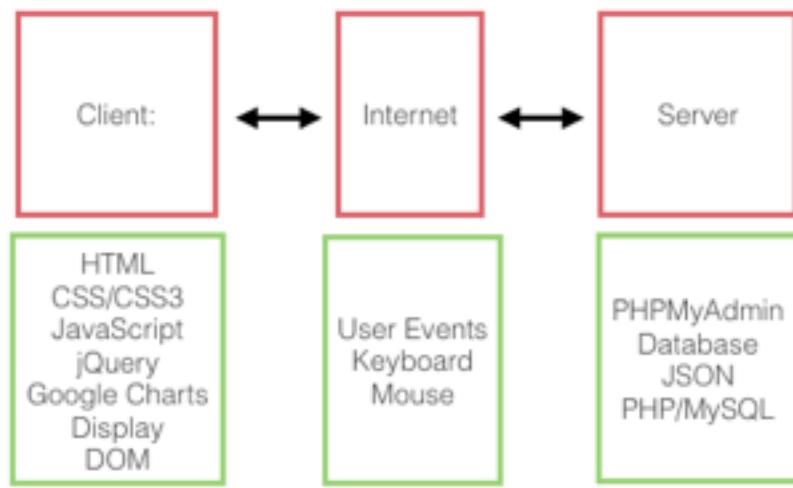


Fig 3.8 Client Server Model Updated

The structure of the system has been altered to suit the changes and problems that were occurred during the implementation process, whilst also trying to compliment the design and style. This is a robust and sustainable system designed to support the functionality of the website.

## User Experience Evolution

### Initial User Experience Design

In the design and planning stage of this project, the final stage is to consider the users experience. This can range from the information they see, how they interact with this information and how they interact and move within the website. The user design will explore the websites content and interactivity, the structure and design of the website and the branding of the entire project.

### Information Architecture

The most important part of the website is the content it is to display. The information available on each page will manipulate how the users move through the website and so it is important that the information is structured clearly and appropriately. With this in mind it is important to assess the fundamental questions first.

#### What is the purpose of the website?

The purpose of the website is to provide a platform which clearly displays information and statistics about various parts of Northern Ireland. Users will come to the site to find out

more about an area of Northern Ireland and they will want to see the information displayed clearly with as little clicks as possible. Through previous research, it was decided to use both charts and text to display the information and content.

Simple, clear and concise. These are the 3 main qualities of the website and the theme of these qualities should echo throughout the entire website and also in the users experience, therefore, the information and content of the website should also echo these qualities. A conscious effort should be made to keep descriptive text simple and clear so that all users will be able to interpret it and also kept to a minimum, so it is concise. The use of charts is important so the content flows well and is easy to interpret.

### Conclusions:

- Information and content needs kept simple and plain.
- It needs to have a clear typography.
- Information needs to be laid out horizontally.
- The content should flow well with both icons and text.
- Images and icons should be simple, straightforward and easily recognisable.
- Information/statistics/numbers etc should pop up or display in the same place on the page where possible, so to keep the display consistent.
- It may be useful to section off the webpage, when displaying the content, to keep similar information together for consistency.

Now that the basic guidelines of the content have been defined a content inventory is used to get a clearer picture. This will help to determine the appropriate structure, navigation and layout of the website and from here the design process can begin.

### **Initial Content Inventory**

The website is relatively small and doesn't have a large structure as when a user searches for a particular place, the results will be shown on the map 'Search' page. Keeping the website as clean and simple as possible is important so not to have unnecessary pages just for the sake of them. Should there be a need for more content it can be added at a later stage and a content inventory can be re-done to assess the pages.

	Navigation title	Page title	Page Content
1.0	Home	Home	General Information, Search Function, Header, Footer, Links to all pages
1.1	Search/Explore	Search	
1.2	About	About	
1.3	Contact	Contact Us	
2.0	Search/Explore	Search	Search, Select, Map, Header, Footer
3.0	About	About	General Information, Header, Footer
4.0	Contact	Contact Us	Contact Information, Form, Header, Footer
5.0		Sitemap	Map of Site Structure

Fig 3.9 Content Inventory

## User Profiles, Journey and Experience Mapping

To help interpret how a user will navigate through the site, example user profile's have been created to show how the site may be used. Mapping out the user's journey and experience when using the site will be very beneficial to see how the flow and interaction of the site is.

### The User's Goal

Any user of this site will have one main goal in common: to find out information. Whether a user has landed on the site and is browsing or if they have purposely visited, each user will be looking to learn or be interested in learning information about their neighbourhood. So information needs to be clearly displayed and easy to access and it should be one of the first things visible after a search.

### The User's Motivation

Motivation to visit this website will vary depending on the type of user. School's and students will visit the site motivated by the work they are learning or teaching, professionals will visit motivated by the work or research they are doing and there will also be a small user group who have been influenced by marketing or through a link provided by another website. Therefore the website and experience should be easy to interpret and suitable to view in schools and workplaces.

### The User's Interaction

The interaction of the user is what tasks and functions they will want to perform when they visit the site. Each user will want to search easily and quickly and also have the results

displayed as quickly and clearly as possible. They will want to interact with the map and have it respond to their actions swiftly.

From this quick evaluation it is possible to mapping the user's experience.



Fig 3.10 User Journey

#### Variables to consider:

Context - Work, Social Environment or in School. Generally it will be in a social environment.

Resources - Mostly it would be used on desk-top computers or laptops, but tablets could be used a learning device.

Capabilities - As a service it could be used by people with all capabilities and it should recognise this.

Progression - Any user will begin with the search or map function and progress swiftly from here.

Functionality - The website should be equipped to carry out all functions like searching or interacting with the map.

Results - The results of a search should be visible and clearly laid out. The info graphics should be clearly visible on the page and have a minimal amount of supporting text.

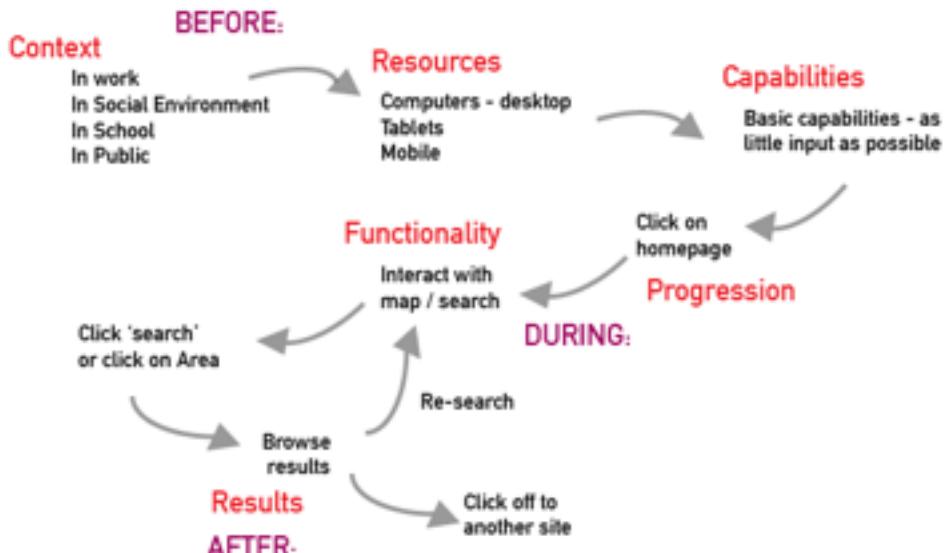


Fig 3.11 User Journey

### User journey example:

Occupation: Geography Student

Purpose for website visit: Research for coursework

A geography student has visits the site after searching for statistics on Northern Ireland. As a visual learner, they have click on 'Digital Nation'. After looking through the homepage and deciding whether to use the service, they click to view the interactive map. They experiment with the map and click on an area that they want to explore. They notice a number of pop up boxes and icons to explore and, subsequently, roll over these icons and read the information available. They scroll down to see further information available in an interactive info-graphic format. A graphic takes there interest and they see information on population, something they visited the site to find out more about. They browse the information and realise they need further, more detailed, information. They then click the link provided to take them to the appropriate place to find the rest of the information they need. Although this is just an example, it is possible for the site to be used like this. As stated before, the aim of this website is to provide a platform for simple and quick statistics, not a comprehensive explanation of each statistic available in Northern Ireland. A site for that already exists and 'Visual Nation's' aim is to provide a platform that displays the most popular statistics in a simplified info-graphic version. User's may use the site to gather what they need but to also point them in the direction of other websites which will give more detailed information. This means the site could be seen as just a gateway to other websites and so it wouldn't necessarily serve a particular purpose but the use of charts and info-graphics gives the site its USP and makes it different to the existing sites.

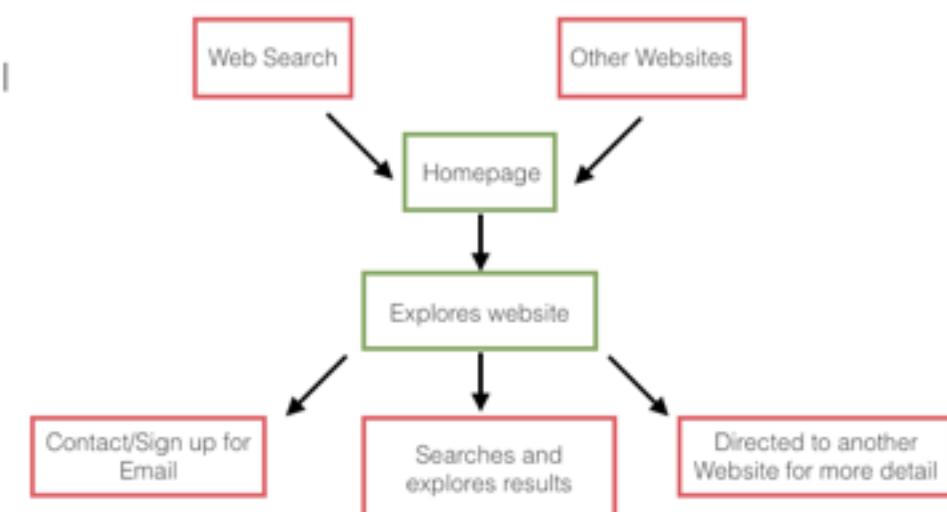


Fig 3.12 User Journey

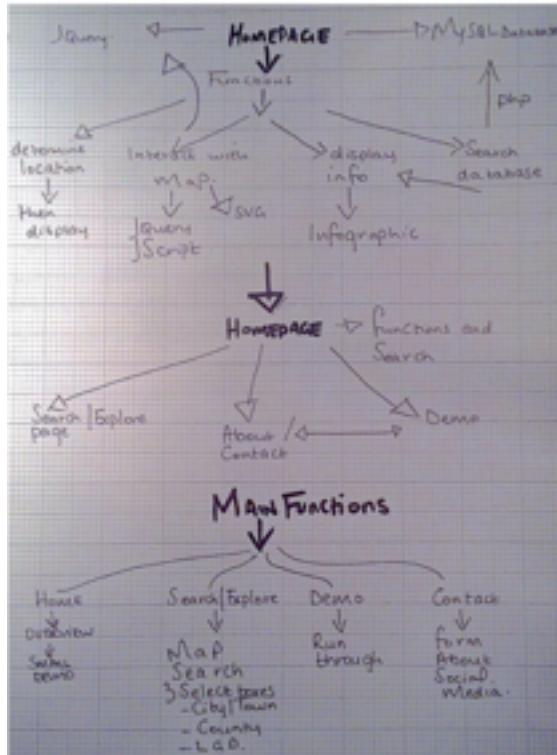


Fig 3.13 User Journey

The above diagram shows how different users might flow through the site, depending on their intention for visiting. Some may visit to search and explore the results, others may move to another website while others may want to get in touch and contact. The two most common reasons for those visiting the site will probably be through a link on another website or through a web search.

Obviously the main user interaction in the site will be exploring and browsing through the site but there are other ways that the user interaction will be applied.

The user will generate data and content, based on their input in the select fields. After they interact and select their chosen area they will be shown a range of data and statistics. Overall, the more a user interacts with the website, the more the website reaches its full capacity. Therefore, information needs to be organised in a way that users can easily click and flow through the website, without complications or having to input too much. Clicks and keyboard events should be minimised and user generated data should be displayed at appropriate points on screen to make it easy to read.

### **Structure - Hierarchy:**

As the website is relatively small the hierarchy and navigation is small too and, therefore, quite simple to interpret. The user will land on the homepage when they first visit the

website and from here that will be able to access every page from the main navigation bar or from the quick links in the footer. throughout the content on each page there may be links to other pages or even other websites, but this depends on the user generated content.

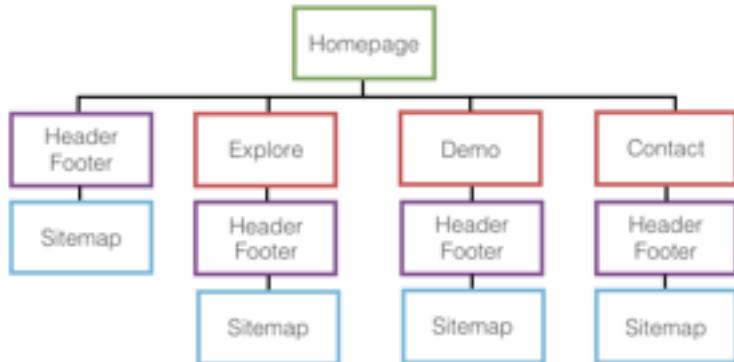


Fig 3.14 Updated Hierarchy

Above shows the hierarchy of the website. It is simple and easy to interpret and links are consistent throughout the website as each page will have links to every page in the header and footer and will also have access to the site map. The header will hold the navigation bar and the footer will have quick links to suitable pages. In a way the site almost flows like a cycle as users can access each page and move swiftly through the website as they need.

### **Structure - Navigation:**

Navigation will be one of the first thing a user notices on the site so it is important to have it well planned out. The options are either horizontal or vertical navigation.

#### Vertical Navigation:

Vertical navigation, or side navigation, can be useful for certain sites, for example if a site requires a lot of scrolling or filtering or if they have a lot of links to include in the main navigation. The navigation would act as a sidebar and the main content would begin from the top of each page.

#### Horizontal Navigation:

Horizontal navigation, or top navigation, is useful for simple sites and is probably the one used most often. It can be included in the header at the top of webpages.

## For VisualNation:

For this project the most appropriate option is to use horizontal navigation. Each page should be able to access every other page easily from the links in the header and this can easily be achieved by using horizontal navigation. This means the navigation will only require a small height on space on a page and the rest of the page can be used for info-graphic and text content. Also, it breaks the page up suitably and, as we read from left to right, makes it easier to read.

Overall the website has a simple structure but this reflects the needs of the content so a simple structure is appropriate. A lot of the activity on the site does happen within one page and, although it should not pose any problems, a plan is ready in the event it that does happen. As the site is small it has the potential to grow and the structure components are designed in a responsive way so that they can grow too, if necessary.

## **Design**

Now that the structure, interaction and information have been defined I can move on to the design phase. This will include designing the visual layout of the pages and documenting how I got to the final design and the components that go with that design.

### **Design - Wireframes**

To begin the design phase the research carried out in the paper prototyping phase was applied here, starting off basic and progressing to a detailed wireframe with all the necessary components, applied to the needs of VisualNation.

By giving the header, footer and content their own div each, the content is free to adapt as necessary and this won't affect the rest of the page. The page title would go at the top, just under the navigation, and below that is the chaining content. The map is in the middle of the page as it is the most important part and it should take preference and underneath should be the results of the search and data and info graphics to go with that. Further wireframes can be seen in the appendix.

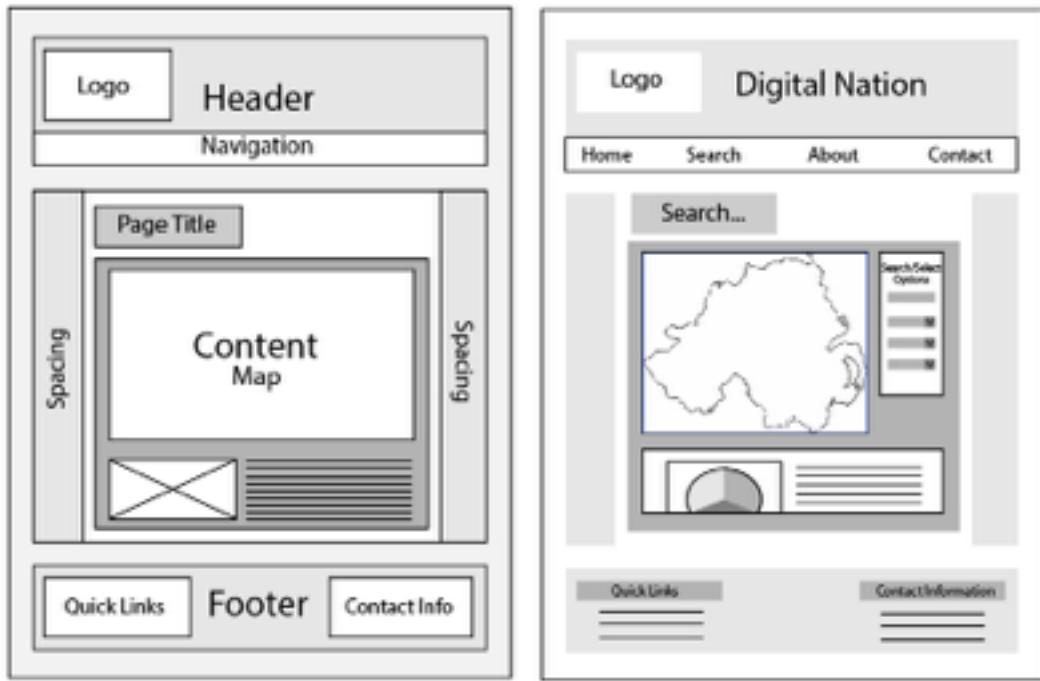


Fig 3.15 Wireframes

## Design - Colours

Before designing the mock-ups and final solutions, the colours and palette of the website need to be considered.

With this project there is an important cultural issue to consider. As the website is about Northern Ireland precautions should be taken when picking the colour scheme to ensure they are not associated with Northern Ireland culture. It is important that the colour scheme is completely neutral. All colours were swatched (appendix) and colours were filtered out to provide possible options. Unfortunately this does not leave many options and there were only 3 useable colours; yellow, purple and pink. Yellow is unsuitable as it is very bright, even toned down, and it would be difficult to read against a light background and would require a dull background. Pink would be unusable as an entire colour scheme, perhaps as detailing, as it too is bright but also some may consider it too feminine and may be put off by the site if it were too pink.

This leaves purple and this is the most appropriate from the options as it can be dark or light but it is also neutral. To help gain a better perspective on the palette I looked at various tones and types of purple (see appendix).

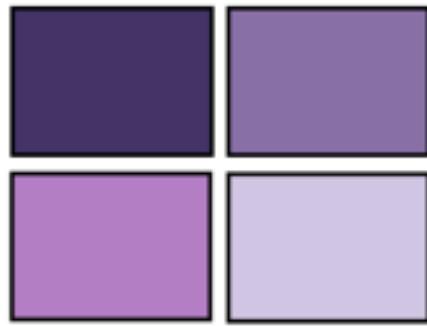


Fig 3.16 Colour Palette

The chosen colours, fig 3.16 above, have been utilised throughout the site, with pink also used for detailing. These colours can be applied to wireframes for mockup testing.

### Design - Mockups and AB testing

Two potential mockups of the 'Explore' page can be seen below. By designing two solutions it can be tested with users to see which is more suitable for the website.

A.



B.

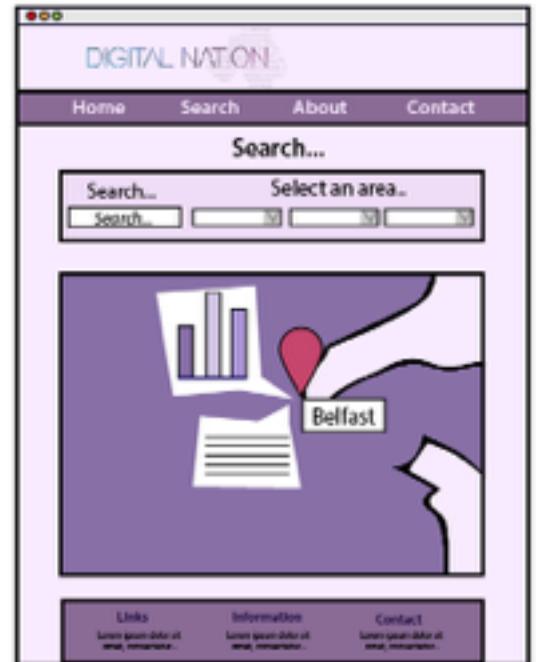


Fig 3.17 Mockup, Fig 3.18 Mockup

**A:** This mock-up uses the purple colour scheme and various tones are used throughout. The navigation is at the top to provide more space and the logo comes underneath this. The map and search options take centre focus in the page and the results can be seen

below this. The footer, like the header, is spread out over the entire width of the page and more subtle colour is used here to make it blend with the rest of the page.

**B:** This mock-up uses a more pink/rosy colour scheme but it still has hints of purple throughout. The logo is at the top and the navigation is below that, to give it more emphasis. The page title follows this and the search options are directly below this and laid out horizontally. The map is a lot bigger as information and results are only shown on the map but they pop up in boxes when necessary. The footer is below this and, again, is the same width as the header to keep the page flowing.

Two potential users of the site were asked to evaluate the mockups.

#### User A - Student

“I like the colour in A better than in B, its more professional but I like the popup boxes in B, it makes it more interactive. Maybe, though, you should be able to see the results as text too.”

#### User B - Civil Servant

“I don’t like the pink at all, and I probably wouldn’t take the site seriously if it was pink. I think the map is too big on the second one and the search options should not be at the top, maybe at the side like in the other one. I like the pop-up boxes too.”

#### Evaluation

- Pink is not a suitable colour
- Select options should be at the side of the map
- pop-up boxes could be integrated in

#### Final Solution

The two options have been combined to give the most optimised version. The map is slightly larger than in option A and the search options are on the right side of the map to make better use of space and everything is slightly wider and is consistent in this to make the page flow more.

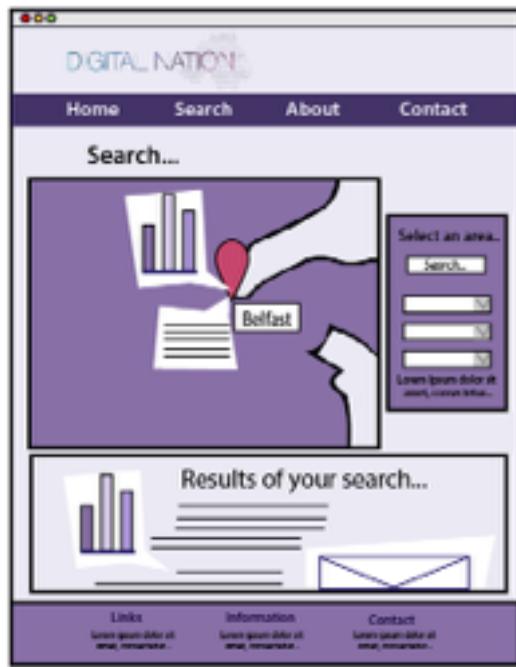


Fig 3.19 Mockup

## Design - Branding

Initially the project began named 'Digital Nation' and so research was carried out with this in mind. Research included mind maps and mood boards to help gain context (see appendix). After sketching the design progressed to experimentation on Adobe Illustrator to determine appropriate fonts and colours for the logo (see appendix). The chosen font was Helvetica Neue - UltraLight.

Digital NATION  
digital NATION

Fig 3.20 Fonts

While researching colour, keeping in mind the chosen purple colour scheme, a tutorial [2] (2014, [abduzeedo.com](http://abduzeedo.com)) was used to incorporate the 'digital' element in to the font.



Fig 3.21 Logo

To incorporate the ‘nation’ aspect in to the logo, an outline of Northern Ireland was used. Look at previous research and creative experimentation the binary aspect inspired the outline.

## **Brand Development**

From the initial logo, major changes occurred and the brand was changed entirely. In peer reviews the initial brand was not well received and it was felt that it did not reflect a strong and individual brand. So research and experimentation began again and inspiration came from the word ‘visual’. ‘VisualNation’ was derived from experimentation and was deemed suitable due to the word play ‘visualisation’, which is a word that best describes this project. Before sketching, design theory was researched for help and Gestalt’s Theory seemed applicable.

*“Gestalt is a psychology term which means “unified whole”. It refers to theories of visual perception developed by German psychologists in the 1920s. These theories attempt to describe how people tend to organize visual elements into groups or unified wholes when certain principles are applied.” [3] (2014, <http://graphicdesign.spokanefalls.edu/>)*

Two principles I used for inspiration were Proximity and Figure.

Sketching began by looking at the concept of ‘visual’ and ‘sight’ and progressed from there, looking at things such as eyes, glasses and magnifying glasses. From here an eye/pie-chart combination logo was developed. The eye, representing ‘visual’, is broken into segments, like a pie-chart, but together they make up an info graphic symbol. This symbol is simple and represents the general idea of the brand.

The final brand developed can be seen below.



Fig 3.21 Final Logo

## **Design Theory**

Now that the site has been structured and designed it can be assessed to determine how useable it is. Through research Maslow's hierarchy of needs was discovered and the principles behind this can be extrapolated and applied to web design. [4] (2014, [sixrevisions.com](http://sixrevisions.com)).

All of the above depend on the Human-Computer Interaction, basically on the needs of the websites users and what their input in to the website will be.

Accessibility is the main building block here and it has been stated that this website needs to be accessible as the user group is so vast. This will be done through accessibility tools at the top of each page and through providing non-colour formats of the web pages. The website needs to be found easily on search engines and the user should have no problems when surfing through the site.

Stability means the website should be trust-worthy and consistent. The information available on the website will be from a government source, with permission, and users are not required to enter any of their information, unless they want to contact us. The database will be secured against any attacks and the website will be designed and closely monitored in a way to prevent failures or going offline. Should this happen there is a plan in place to deal with situations like this. This ties in with Reliability as users need to be able to rely on the site to be available, to be found easily and to be trustworthy and secure with their information should they enter it.

Usability can be tied in with accessibility but there should also be an importance on the flow through the site as users browse. Useful links should be provided where appropriate and, as stated before, users may only visit for a short while before moving to another more detailed site but this experience should be as smooth as possible.

Functionality and Flexibility can go hand in hand as the website should provide all functions and tools for the best user experience but also adapt to each user when necessary. This can include being a responsive site and also providing geo-location services on the map so users can find their current position.

## **Human Computer Interaction Principles**

At this point it is useful to recall HCI principles to make sure the design and experience doesn't get lost in the development process. Norman's Design Principles (D. Norman, 1986) will be used to asses the interaction design of the site.

Visibility - Functions and shortcuts should be visible and available to the user so they can make the best use of them. Currently, the main functions of the map are easy to spot and see and the search function is still being developed.

Feedback - Code should be developed to send information back to the console to asses speed and performance issues. A contact form is included in the site, although it could be re-marketed as feedback.

Constraints - User constraints should be kept in mind when designing and this includes accessibility issues.

Mapping - For this principle it is useful tried to think like a user. Where am I and where do I want to go? Appropriate links and information have been incorporated where applicable so users can browse easily.

Consistency - This is very important and all aspects of the site should be consistent with the brand. Similar colours, styles and fonts have been used throughout to keep the visual layout and functionality consistent.

Affordance - Users should know how to use the website and buttons, links and other elements should be easy to recognise.

## **Usability Principles**

Three principles that should be considered are the usability principles defined in the book Human Computer Interaction (Dix *et al*, 2003). The book states that learnability, flexibility and robustness should be considered in user experience design and an effort has been made to incorporate these principles in. Designing with these principles in mind helps develop the user experience. The website is flexible to users needs, with the use of

accessibility and is built using robust and sustainable systems and tools. At this point, however, the learnability of the site is not evident and so this is something that should be considered in future development.

## **Implementation process**

During the implementation process there were many goals achieved, problems created and elements developed. The tools planned to be used were sometimes not suitable and resources, such as time, were, as a result, wasted. In the evaluation section there will be more detail about how effective the process was.

The implementation process began by roughly coding and styling the website to get a clear vision of layout and spacing on the site. Once this was achieved the main functionality of the website was focused on and this included developing the database, the interactive map API and linking the two. At this point there were many challenges faced and time was spent on developing the best way, from the user experience point of view, to work with the website. The final stage included finalising the styling, implementing the accessibility, the responsive options and other finishing touches.

## **Tools and Resources**

The various tools and resources used throughout vary from software, such as Adobe Illustrator, to JavaScript Plugins.

### Markup

HTML and CSS make up the basics of the website and these are easy to use, easy to interpret and vital. There is no substitute to basic web languages so these were included from the beginning. Working with these languages was simple as there was a lot of experience available with these languages and there is a plethora of support available online.

### Script

JavaScript is an important part of the functionality in VisualNation. This language was chosen because of the interactivity it adds to a site and there are many uses of JavaScript,

including AJAX and jQuery, and it provides a suitable like between browser and database. This language was mostly simple enough to use, as again there is experience here, but it posed some problems, particularly with the implementation of AJAX.

### PHPMyAdmin MySQL Database

This technology was chosen as it provides a robust and useable platform to store data and it also is easy to implement with the university servers. There is experience with this technology, it allows the use of PHP to query the database and it provides easy storage of information and statistics.

### Google Charts API

This tool was introduced to the project at a later stage but it proved to be one of the most useful tools, as it displays the charts for the statistics. Implementing this technology was difficult and meant that more time was unfortunately spent on this. The API is a handy and useful tool that allows interactivity in charts and so it was an easy decision to use it.

### OpenStreetMap and MapBox

These resources work together to provide the map. OpenStreetMap is an open source mapping software that is free to use any way necessary and MapBox is a resource that styles those maps and adds interactivity to them. As these maps allow custom styling it was better to choose this than another mapping software that restricts usability, like Google Maps.

## **Using the Technologies**

HTML and CSS have been employed throughout the site continually and are edited and developed to suit the needs of the functionality. The main use of tools and technologies comes with implementing scripting languages, the database and the various API's.

### **Script**

JavaScript has been used throughout the project and one of the main uses is with **AJAX**, which is used to call data from the database and load it into the charts. When an area is selected a function is called to start an AJAX request function `drawChart(num) { $.ajax` and this, consequently, calls a specific PHP script to query the database and parse the results into **JSON** format. These results are then interpreted by the AJAX call and loaded

into the correct format for the Google Charts and then loaded into the charts and corresponding divs.

JavaScript is also implemented through the **jQuery** plug-in which is used for accessibility reasons and for the map element. The accessibility functions was achieved by using a jQuery plugin called [jfontsize.js \[5\] \(2014,https://github.com/ouvrages/jfontsize\)](https://github.com/ouvrages/jfontsize) which uses predefined functions to alter font sizes of the entire body when clicked. jQuery is also implemented in the use of calling different style sheets when users want to change the colours of the website.

**GeoJSON** is a format for storing geographical based information and is a geographical optimised version of JSON. This technology was implemented to the project at a later stage and it used to create the Local Government Areas layer for the map. This is a temperamental technology as it needs to be used correctly it requires a lot of trial and error. The script for the map calls to a GeoJSON file which contains many statistical points to create polygons of areas. Properties for each polygon is defined at the beginning of the node of coordinates and the type is declared as [polygon](#).

```
        "type": "Feature",
        "properties": {
            "fill": "#F5D3DF",
            "stroke-width": "4",
            "stroke": "#B72F5A",
            "stroke-opacity": 0.5,
            "fill-opacity": 0.3,
            "title": "Fermanagh"
        },
        "geometry": {
            "type": "Polygon",
            "coordinates": [
                [
                    [
                        [
                            -8.161468505859375,
                            54.441097755838854
                        ],
                        ...
                    ]
                ]
            ]
        }
    },
```

Fig 4.1 GeoJson

# PHP and Database

Implementing this technology was easy and straightforward. A [PHPMyAdmin](#) database was created and altered throughout the implementation process as necessary as tables were added and deleted. [PHP MySQL](#) code has been implemented to query the database for statistics when an AJAX call is made. Three types of PHP queries are used, one for each chart. It is also used to populate the select list in `explore.php`.

## Google Chart API

This technology is used to display the charts and was difficult to use, as the **JSON** format was tricky to get right. The charts require a link to [google.com/jsapi](http://google.com/jsapi) which allows the use of their visualisation packages. The data that is received from the AJAX call must be loaded into the correct format to be stored in the **DataTable** which then loads data in to the charts. This function took a long time to implement, and so, other features of the site suffered as a result.

## MapBox

This API requires the use of the [mapbox.js](#) library and **jQuery** to load the map into a webpage. Maps can be customised by creating an account and deciding on the styling and whether any features want to be added, such as markers. This API has a lot of potential for interactivity but learning the script language was difficult and time consuming and so the map is not as developed as it could be, but this leaves room for future development.

## Challenges Faced

Throughout the process there were many challenges faced, which affected the final outcome of the product.

The first major challenge was incorporating the search function with the map. The initial idea was that users could search for their area and the map would zoom to this area and simply the corresponding statistics. The first problem here was getting the search to work with the map. The MapBox API provides a search box, within the map container, and users can easily search and zoom, however this was difficult to incorporate with the visual nation database. The mapbox.js file holds the search functions and it was almost impossible to extract these functions and link them to the database of statistics. It was not possible, due to lack of time, to get the search within the map to then search the database and so users, unfortunately, cannot search for any area. Reasons for this are due to the complexity of the mapbox script but also because of the restrictions on the statistics available.

The next problem was the nature of the information from NISRA who work with complex and specific government defined areas, so data is not available based on towns or cities. There are many geographical levels of data available and they range from hundred and

thousands of small areas to 5 health trusts. Collating data was not supposed to take a long time and so the most useable and realistic geography available was Local Government Districts; 26 areas throughout NI. Using this geography meant using pre-defined areas so searching for a specific town would mean creating a database of every town and village within each LGD, which would take a long time and there were no API's or plug-ins available to help this process. To overcome this a select box at the side of the map is used instead of a search function as it takes less time to retrieve data and due to time restrictions it was the most suitable option. This problem was dealt with using the strategy in place to deal with unexpected problems. It was assessed, researched to find any available options and then the most suitable option to keep the function working was chosen.

The next major problem was dealing with the layers on the map. As the data is only in LGD format it was important to have a layer that users could toggle on the map so they could see which boundary their town or city was in, otherwise many users would find the service did not fulfil their needs. The first problem was creating the layer itself and deciding whether this should be built using raw data or using MapBox's software TileMill. TileMill is a program that allow complete customisation of maps, but using this means layers cannot be toggled on or off and this was not functional. The layer was drew in tile mill using GeoJSON coordinates but it was discovered that it could not be toggled. The next option was to use draw the LGD boundary file, transfer this on to the computer and then use [geojson.io](http://geojson.io) [6] (2014, <http://geojson.io/>) to draw the shape file and output the raw GeoJSON coordinates. Each boundary in the shape file was given specific styling properties, hand coded in to the file, and this was a lengthy process as each the format needs to be perfectly correct. [geojsonlint.com](http://geojsonlint.com) [7] (2014, <http://geojsonlint.com/>) was used as a validator for the formatting. This shape file was then saved and loaded in to the map using the mapbox.js language to load the url of the layer and parse the file and add that to the specific coordinates of the map. This layer is can be toggled, which is an important feature as users will want to see which boundary they live in but they may also just want to explore the map.

Other problems encountered were based around the fact that time was limited and, as a result, many elements of the website did not get developed properly or at all. This includes the function of responsive design and getting the site to function correctly on a phone or tablet. The CSS was coded using percentages and em's where possible, although in some

parts fixed and static widths have been used. If there was enough time this could have developed in to making a responsive site where everything scales down based on screen size. To do this media queries would have been used. The site does function well on various screen sizes, for example on a desktop computer and on a smaller laptop, and the display on a tablet is not perfect but it is acceptable. If more time were available it would have been possible to scale the site and make it responsive.

Alongside this was the implementation of geo-location services, which would have been useful on a mobile device. Integrating this function with MapBox was difficult and the script needed would often break other MapBox JavaScript in the map. When adding geo-location services the layer toggle function would not work as it was over written by the geo-location script. A decision was made to determine which function had more value and added to the user experience and the layer proved more valuable as it helped users see which area they lived in. Again, like the responsive design, this allows opportunity for development in the future.

## Achievements

The main achievements in the project is the functionality of the website. The use of AJAX, which can be complicated to work with, shows use of JavaScript, http request objects and integration with a database whilst also formatting data in the form of JSON. As explained above, the AJAX successfully links to the PHPMyAdmin database and returns the data in the form of JSON which was an intricate task to achieve. The JSON had to be in exactly the correct format, with a specific layout of square brackets, commas and curly braces, whilst also displaying the correct variables, names and types.

```
{"cols": [ {  
    "label": "Percentage", "type": "string" }, {  
    "label": "Value", "type": "number" } ],  
  "rows": [ {  
    "c": [ {  
        "v": "Population (%)",  
        "v": 15 } ], {  
        "c": [ {  
            "v": "Rest of NI (%)",  
            "v": 84 } ]  
    }  
  }]
```

Fig 4.2 JSON

Above is the necessary JSON format, including the specific labels; ‘c’ and ‘v’. These values represent the columns and rows in the [DataTable](#).

Other notable achievements in the development include the integration of API’s. MapBox and Google Charts API were both successfully used and configured to suit the needs of the project. This also shows another achievement which is the use of dynamic data-driven interactive charts. The user can hover over a segment of a pie chart and see that value whilst also compare it to other values on the page.

Another functional requirement achieved was the integration of accessibility functions. This includes JavaScript to change text sizes and colour contrasts. This was important to achieve as it was one of the main requirements in of the project and it is important that the website caters for the needs of all users.

Overall, the implementation process had positives and negatives but it was a huge learning experience. The knowledge and skills gained can be extrapolated and applied to many other uses and the learning of new technologies has been valuable. However, not all functional requirements were achieved in the best way possible and sacrifices were made. This shows that perhaps more planning and decisions making was needed earlier in the process.

# Testing

## Testing Approach

The next stage in the project is to test the product and determine its usability and whether it is fit for purpose. As this project is using the Waterfall methodology this is the next logical step in the process. Code has been validated throughout the development process and some minor peer review has been ongoing when a decision needs made, but this testing will test the entire structure and its feasibility.

The approach to testing will be through user surveys and task sheets. The first test will be done using the White-box/Black-Box testing method.

*“Black box testing. This approach tests all possible combinations of end-user actions. Black box testing assumes no knowledge of code and is intended to simulate the end-user experience.” [8] (2014, Microsoft)*

*“White box testing. In white box testing, you create test cases by looking at the code to detect any potential failure scenarios.” [9] (2014, Microsoft)*

This method involves using a user who does not know anything about the project (the black box) and a user who is aware of some of the method and functionality of the project (a white box). This method has been chosen because it gives a clear picture of the test results from both perspectives, it can help to show errors in the code or the user experience, it is cost effective and it can be tested by the target audience.

To begin this process two users were selected. User A is a professional who works in the government and could potentially need to know demographic information for research purposes. User B is a peer, who has a basic understanding of web development, and they have been made aware of some of the functionality and methods in the site. The task sheets and questions can be seen in the appendix.

The second testing process involved a user survey tested by 4 different users, from various educational and professional backgrounds.

## **Testing Results**

### **White/Black Box Testing**

Each user was given a pre-task interview to gain a quick understanding of them. They were given 9 tasks to complete, and asked to comment on each. After, a final post-task interview was conducted to gather their opinions.

#### **User A**

The general opinion from user A was positive. From the pre interview it was discovered that this user would not find this site useful and further comment explained that this was because they didn't require a need for it in their job, but they found it interesting. They weren't aware of any existing competition and at first glance found the sites purpose clear.

They found the interaction easy to interpret such as the navigation and the map function. They were able to complete all tasks without difficulty and managed to describe the correct actions after completing a task e.g. after an area is selected the charts appear. They said that markers, areas and chart titles were clearly defined and responded well to the layer option and that it helped to make the areas more defined. The site functioned well during testing and the data was loaded dynamically. They did not need to use the accessibility options but found them easy to use and also found it easy to find other pages in the site.

The positives from User A feedback show that the site is easy to use, the layers are well received and they would return to the site again. The negatives from their feedback show that a search function is desired and the charts could be made bigger. Overall the feedback shows that the site main functions work and the style and layout is well received. As anticipated, a search option would be desired to help interpret the map.

#### **User B**

The general opinion from user B was also positive, but more had more constructive criticism. From the pre interview they told us that they would find the website useful for academic purposes and they found the purpose of the site clear from the beginning.

They were able to navigate the site easily and found the interaction satisfactory, using both the mouse and map controls to zoom into the map. The markers on the map were

confusing and perhaps there are too many bunched together, which is constructive and helpful for development. Again, they responded well to the layer option and commented that, although it does not compensate for a lack of search option, it makes the map easier to interpret. Again, they were able to describe what functions should happen after events are triggered although the accessibility was a downfall here. The accessibility does not effectively change the colours as, when a user selects the black and white option, the flow of the page is disturbed and user B noticed this. Again, this gives direction for future development. They were also able to easily locate other pages of the site.

The positives from user B are that the site functions well and looks good, and the navigation and select functions were easy to use. The negatives, again, are due to the lack of search function and the layer toggle option was not evident on first glance. Other constructive feedback from user B was the suggestion of filter options so a user could filter areas to see all statistics for each area e.g. show population for each area. All of the feedback was useful and helpful.

### **Comparing The Feedback**

By comparing both users a general opinion can be gained. Both users found the main functions of the site to work well and they were pleased with the functionality. Neither mentioned the lack of responsive web design, which means it may not be as necessary as initially thought. Both users would like to see the integration of a search function which shows it should be included in the future.

### **User Survey Results**

The other testing was done through user surveys, where 4 different users were asked 10 questions where they had to rate features of the site from 1 to 10. These surveys can be found in the appendices.

The general opinion shows the purpose of the site is relatively clear and the style and look is strong, with all agreeing that a neutral colour scheme is in place. The simplicity and consistency of the navigation scored above 7 for all users, which is positive. The common negatives are the difficulties when selecting an area to view information on, and comments show that this is because of the lack of search option. Another downfall was the accessibility options as, those who were from a non web background found some

difficulties in understanding what the accessibility options were for. This is contrastive and a label could be added to the box for guidance. The ease of use, interaction and general opinion on the site were all positive with all rating above 8 for the possibility of revisiting the site.

Some comments were left and these provided more ideas for further development. An idea was raised where each boundary in the layer could be clickable to then see further information, and this could be integrated in future development.

Overall, the feedback from testing has been positive and useful as many good ideas have been provided. A search option is now vital if the site were to be useable and so this option should be integrated with the map and the layer so all aspects of are selection work in sync.

## Further Testing

Other testing includes browser testing and code validation. The first stage of this was to test the site in each of the major 5 browsers, this include Google Chrome, Safari, Mozilla Firefox, Opera and Internet Explorer.

The results show that the site operates well in Chrome, Safari, Firefox and Opera.



Fig 5.1 FireFox Testing



Fig 5.2 Chrome Testing



Fig 5.3 Safari Testing

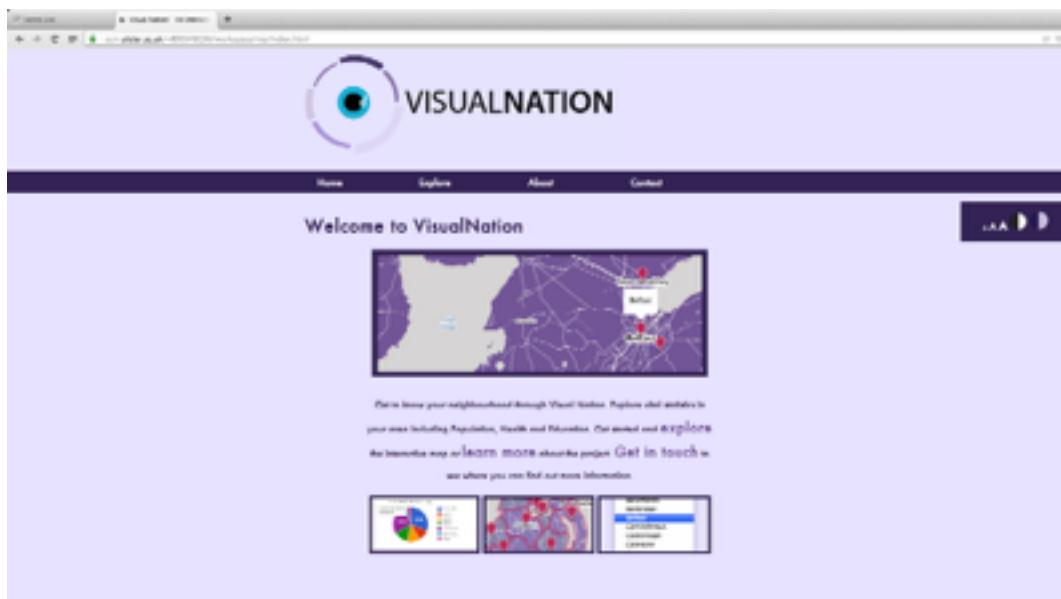


Fig 5.4 Opera Testing

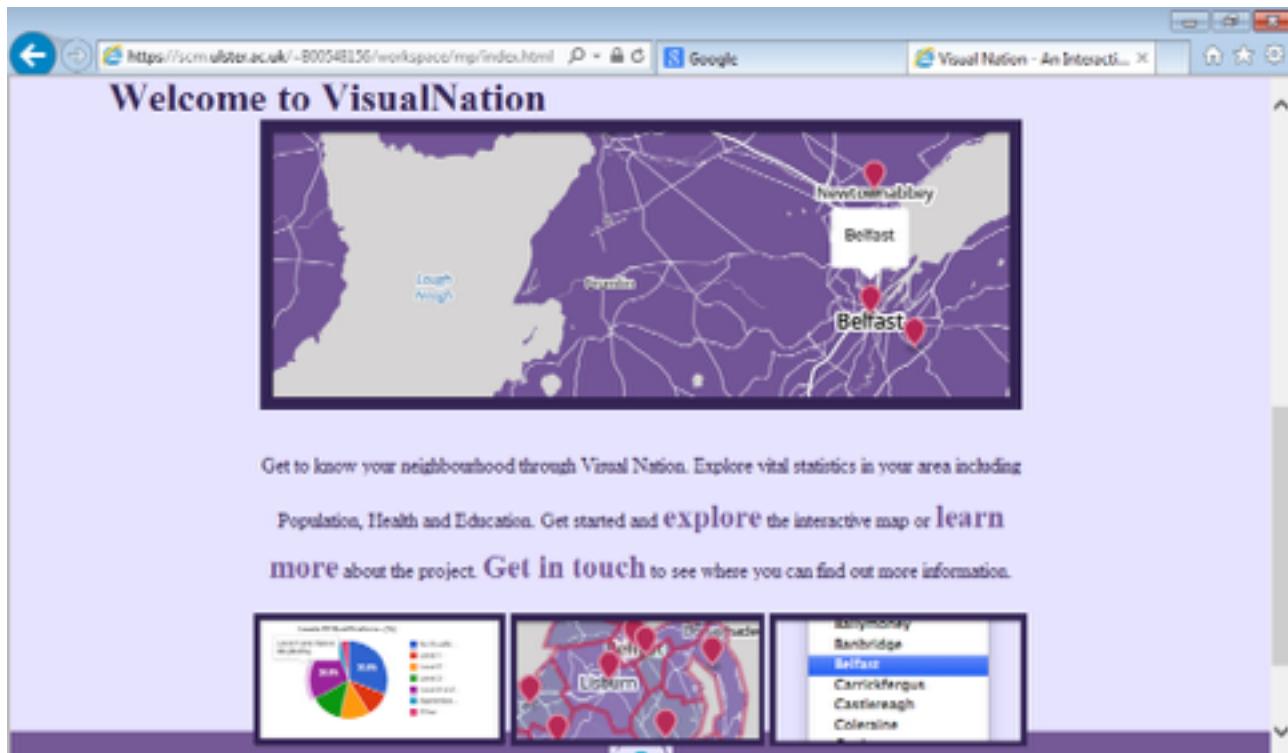


Fig 5.5 Internet Explorer Testing

The website was tested in Internet explorer and it was here where the main problems occurred. The font is not recognised and the layout is strange. This is not acceptable for accessibility reasons and so more development would be needed here to improve this.

It is also important to test and validate the code to ensure it is compliant with W3C standards. Each page was tested to ensure it was valid and each page passed the test. The test results can be seen in Appendix A.

## Evaluation

At this point in the process, an evaluation is performed on the outcomes of the project, the methodology, the project plan whilst comparing it against the project requirements.

Evaluation has been carried out throughout this report, in the tools and resources, the implementation and in the testing, and this section will provide an evaluation of the overall process and the plan.

### Project outcomes

To determine the project outcomes a questions should be asked; what has this project achieved? Here the outcomes will be assessed whilst also compared to the project requirements.

VisualNation has achieved an interactive platform for successfully displaying information and statistics. This is a major achievement as this function is the biggest feature and means the fundamental feature of the website works. A major functional requirement was to “*...display, clearly, statistical information that is relevant in an interactive format...*”, which is achieved, however the methods behind this function may not be what was intended.

The next major outcome of the project is the use of a mapping system where users can view their area. This has been successfully integrated into the project and the map reacts and responds to users inputs. This outcome integrates two of the functional requirements: “*...incorporated with a mapping system to allow users to view their current area and display the corresponding information for that area within an interactive map...*” and “*...Should accept user input events including text/keyboard and mouse events through languages such as JavaScript and jQuery...*”. The interaction from user input and events has been achieved, however the integration of geo-location services has not and this affects the feasibility of the project. Although it was not alluded to in the user testing, this feature could help to increase the interactivity in the site and can only be beneficial.

Another positive outcome is the accessible nature of the site, which was a major non-functional requirement. “*...should be accessible with options to change fonts, sizes and colours...*”. This is achieved through the accessibility JavaScript functions and adds to the

interactivity of the website. The fact that the site can cater for different needs is positive should this website have a large public audience in the future.

Other project outcomes are not as positive, but these provide a learning experience. This process has resulted in a non-responsive website that doesn't function to its full potential on a tablet. Although this was not a defined requirement, this was a personal goal and unfortunately it has not been achieved due to lack of time. Another functional requirement was to "...search the database for information..." which has not been achieved, due to the complexity of the API's used and the type of information available. This outcome means that perhaps the project is too big to be completed by one person, as data formatting and collating is a huge part of this process. This has identified a niche for a complimentary data formatting service which can be integrated with VisualNation's database, so there is development for an entirely new project, not just on VisualNation.

Other outcomes of the project can be linked with the requirements. This includes fully functional dynamic data requests, which link to a database of statistics, whilst load quickly and without problems. The project also satisfies the brief and a working solution has been created, which is safe and user and environmentally friendly. The colour scheme is neutral and suitable for a project of this nature, whilst the system is robust and produces little error.

Overall, the positive outcomes of the project outweigh the negatives as there is a good opportunity for growth, development and the learning has been extremely beneficial.

## **Methodology and Plan**

The methodology has been successfully used to provide plan and structure to the process. As this was a simple and low level project, waterfall was chosen to keep the process flowing and simple. Initially, the methodology was working well and a flowing work pace was used as the project developed through definition, design and then implementation. A gantt chart was used to help manage time, which waterfall does not do. Each stage was followed and the project did flow through these effectively, however the implementation process used more time than planned and so some functionality suffered as a result, but testing and evaluation were still given time. The stage where more time should have been spent is the 'Analysis' stage. At this point any potential risks and problems should have been identified and suitable research should have been conducted to explore the advantages and disadvantages of each technology to be used. Whilst this stage did

happen the results did not anticipate some of the problems that occurred, for example integrating the search function. The methodology has been useful in providing flow and direction to the project, but more effective time planning is required.

The plan of the project has been effective, except for the small issue of time management, but that is a personal issue rather than an issue with the plan. As each major requirement was achieved, the plan has been effective and helped to give guidance when necessary.

## **Notable Findings**

There have been a number of findings discovered throughout this process.

- Data visualisation is a growing method of representing data but it requires a lot of data formatting and this takes time, which was not accounted for when creating a gantt chart
- Users are more concerned with function over form and commented more on the features and functionality of the website in testing, rather than the style and layout.
- The lack of responsive design on the site was not picked up on during testing and so more research would be required to test whether this is necessary or whether this type of website would mostly be used on desktop browsers.
- Users like to be able to search for what they want to see, rather than be told what to pick, so a search function is necessary for future versions of this project.
- Using a program application is not necessarily the best way to conduct a task. When creating a shape file the best method was to compile the GeoJSON file by itself to draw polygons and insert this on to the map manually.

Overall the process has been lengthy and sometimes difficult but the effectiveness of the site stands out against the obstacles. A fully functional solution to the brief has been created and this solution incorporates many methods of web development, including JavaScript and PHP, and project planning and management. This evaluation has helped to discover that more initial research into the specific tools and technologies, not just the languages, was required. More research on the API's being used would have helped to discover any problems at an earlier stage and, therefore, they could have been dealt with and avoided sooner, meaning more time for the implementation.

## **Conclusion**

The entire process of this project has been a valuable learning experience. From the initial concept, defined many months ago, a working solution has been produced to satisfy the initial brief.

The process began by generating ideas to evolve to a defined suitable concept. This concept was tested in various ways, including prototyping and feasibility testing to determine how realistic achieving the product would be. This produced functional and non functional requirements which helped to mould the design of the entire system. Data and logic design were applied to develop a suitable database and system that was supported by a simple but effective user design, based on the idea of developing a simple user flow in the experience. The design and testing were combined with the initial planning to begin the implementation process, where the biggest learning opportunities arose. New technologies and methods were discovered whilst problems arose and effective management was needed to make informed decisions, based on the greater good of the project. The implementation process brought many challenges and proved that, perhaps, more initial planning and research on the API's was necessary. Testing the project followed this and this confirmed that a functional solution had been produced, that tested relatively well with users. The above method follows the Waterfall methodology which was applied throughout the process. The final stage was to evaluate the outcomes and final solution against the requirements to assess how successful the project has been.

## **Personal Reflection**

This process has been lengthy, but it has provided valuable experience that I can use in my future. Overall this has been a positive experience, but also a challenge that has required intellect, strategic thinking and effective management. Managing this process has been difficult but the experience has allowed me to assess my personal strengths and weaknesses, and effective time management is a weakness that has been evident in this process. Time spent developing a search function for the site and integrating Google Charts into the site has meant that the functionality has suffered, but the main functionality still works. I am happy with my performance as I think the effort from the past few months shows in my understanding of each function and the code behind it.

One of the most valuable experience has been what I have learnt. I now have experience in data formatting, something I had not used before, and I understand the structure and logic behind formatting data correctly. New technologies such as GeoJSON have been introduced to the project and this is something that can be developed in the future. There are many other opportunities for future development in this project, which is a good thing. There are opportunities now to make the site responsive, although testing shows this isn't a huge priority but it is still recommended so as to cater for all markets. Other development could be from new types of data and formats for displaying this data and also developing features such as the layer on the map and introducing filters to the data.

I am satisfied with the help and guidance received from my mentor and from the staff from the School of Computing and Maths. However, the feedback and interaction from the DES staff has been poor and, as a result, I felt that the design of the site wasn't as effective as it could have been.

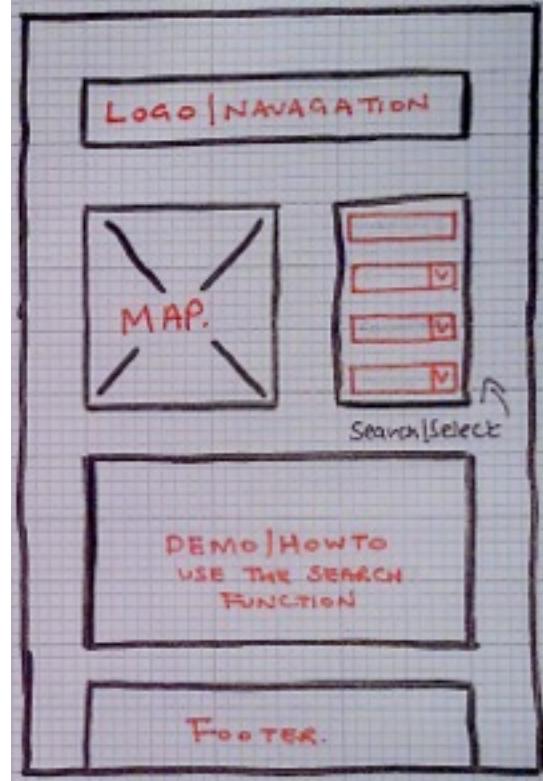
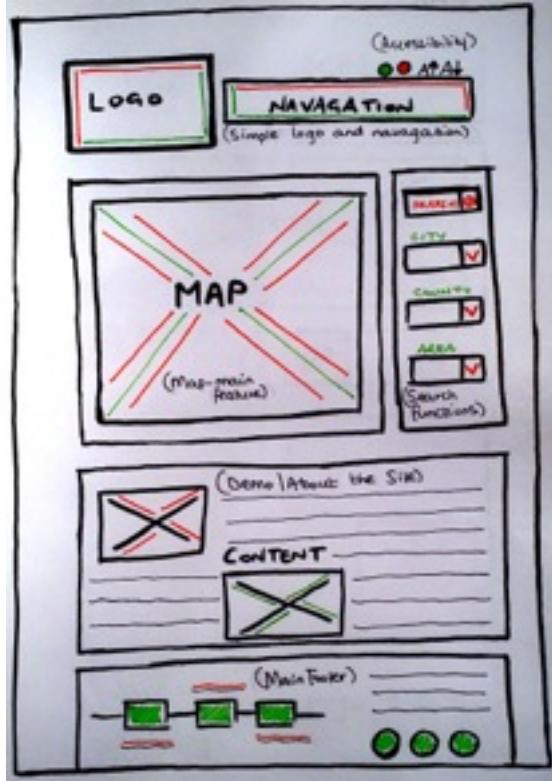
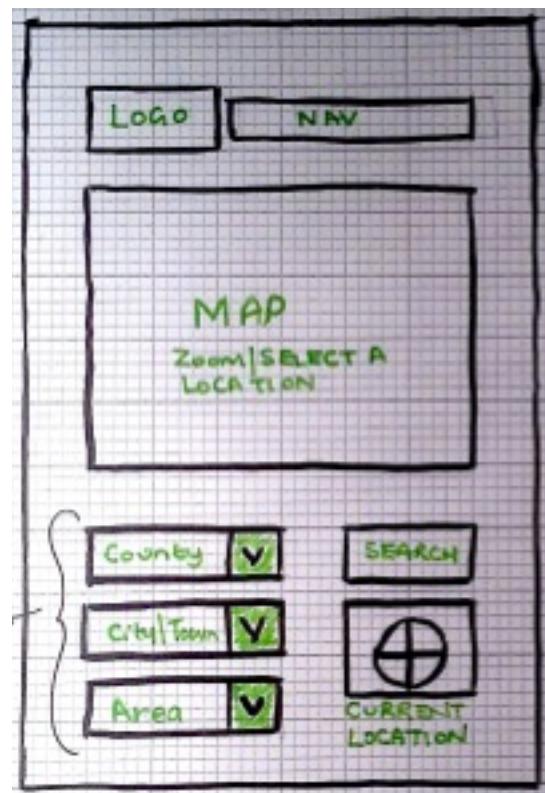
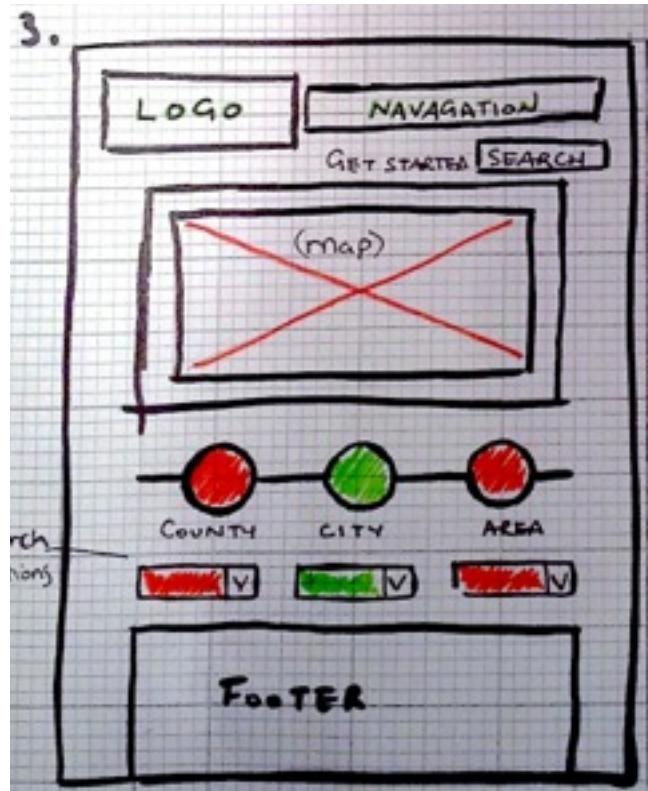
If there was more time, a search function would have been ideal to make the users experience better and I am disappointed that I wasn't able to make this happen, as I think I would have been capable. Again, I would have liked to make the site responsive so it caters for all needs. But not all is lost as there were new technologies learnt and I feel experience in data visualisation and this is something that I could possibly work with in the future, perhaps in my career. I have found a way to take my skills from web development and apply them to a feature, like data visualisation, and this is something I am proud of.

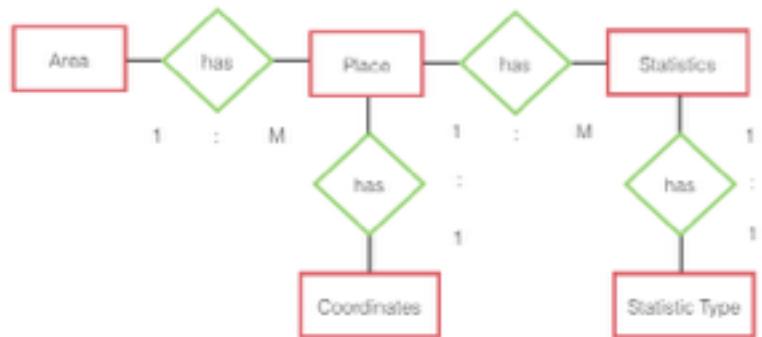
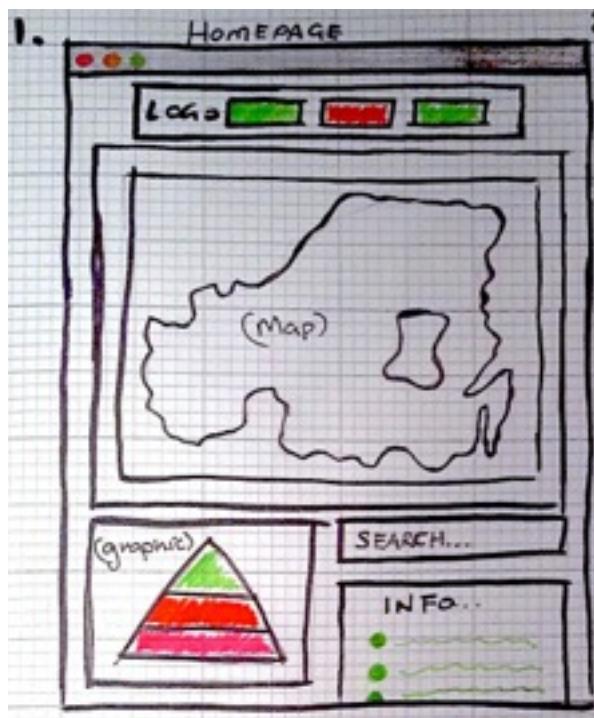
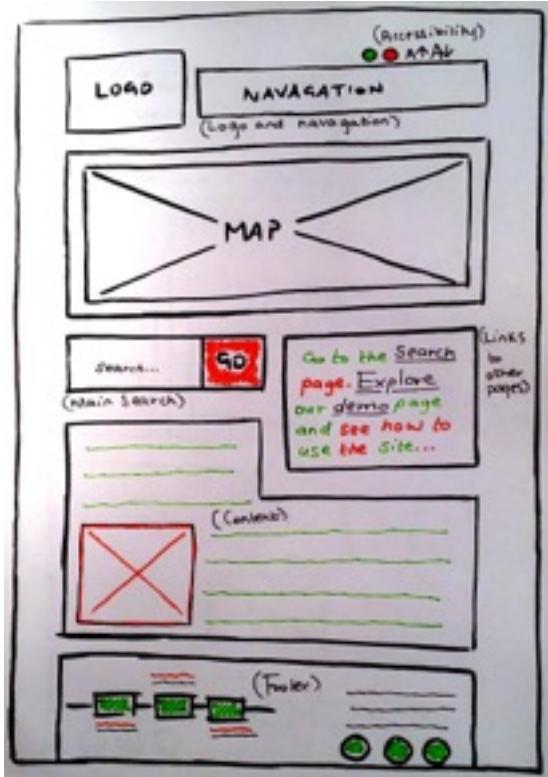
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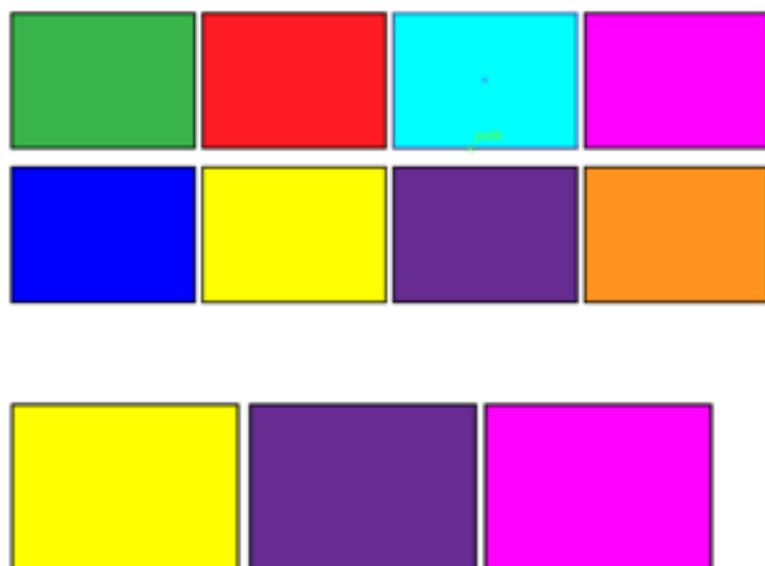
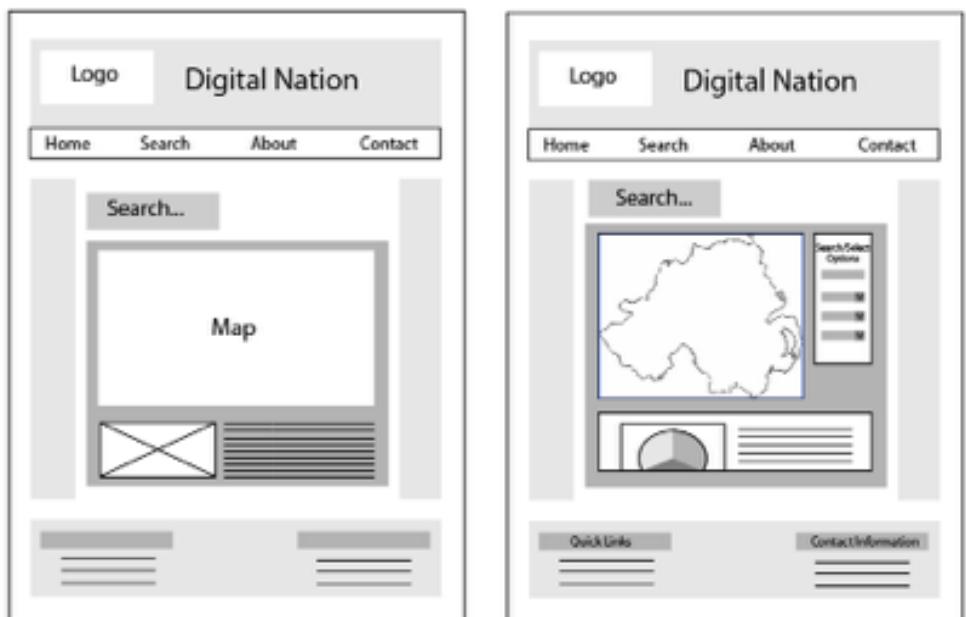
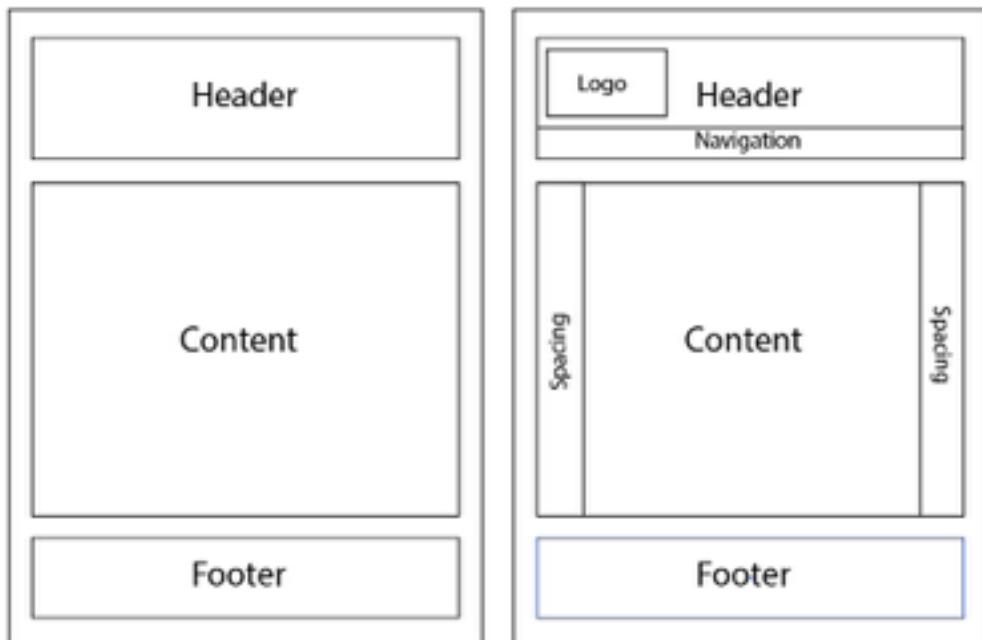
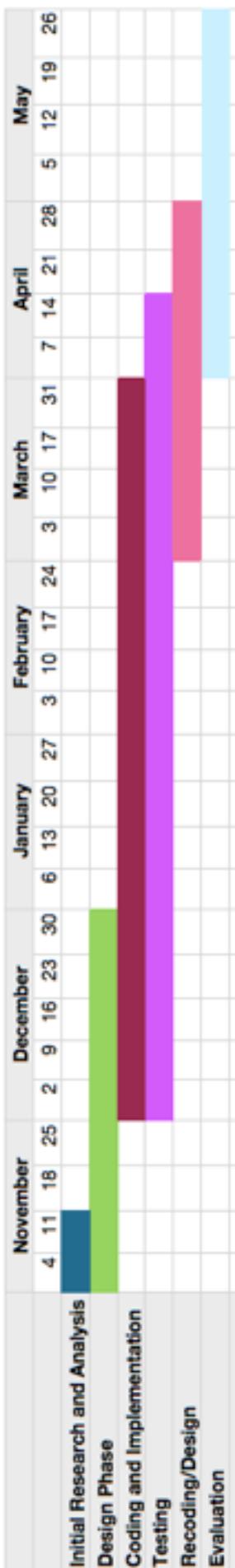
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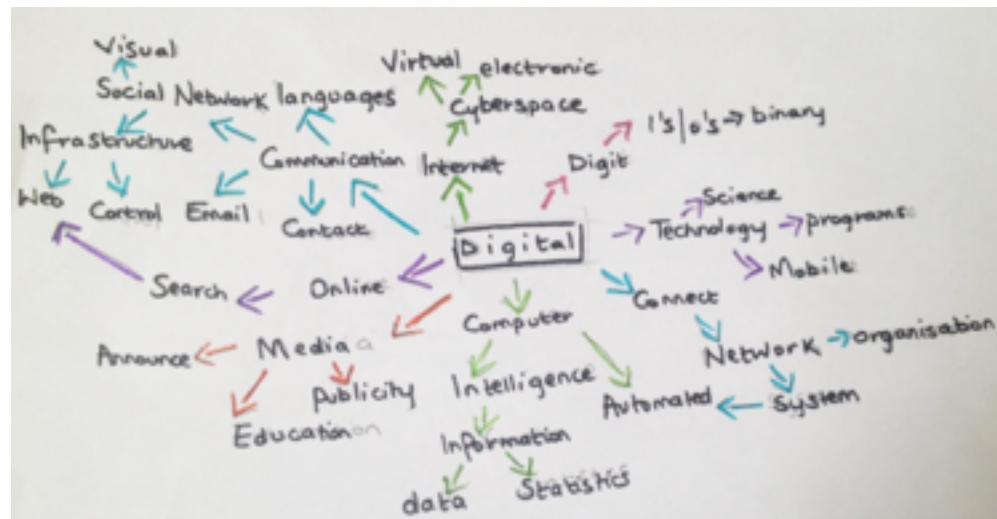
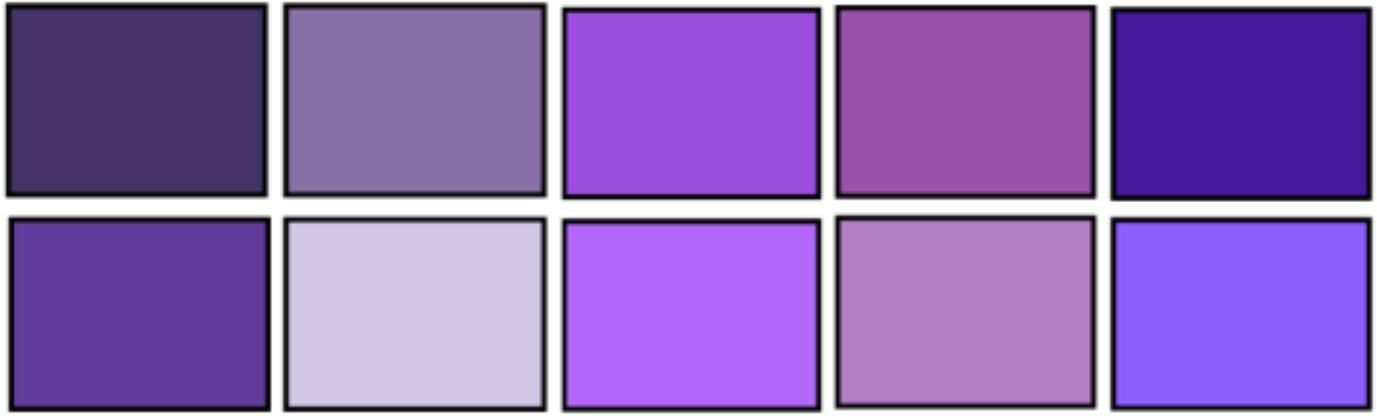
## Appendix A

3.



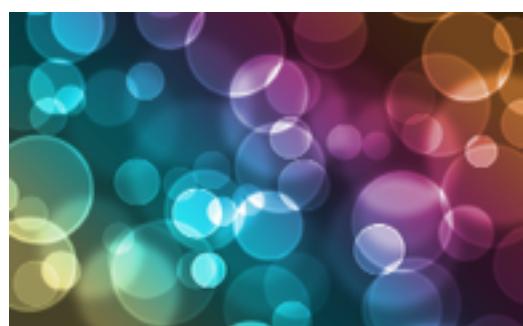








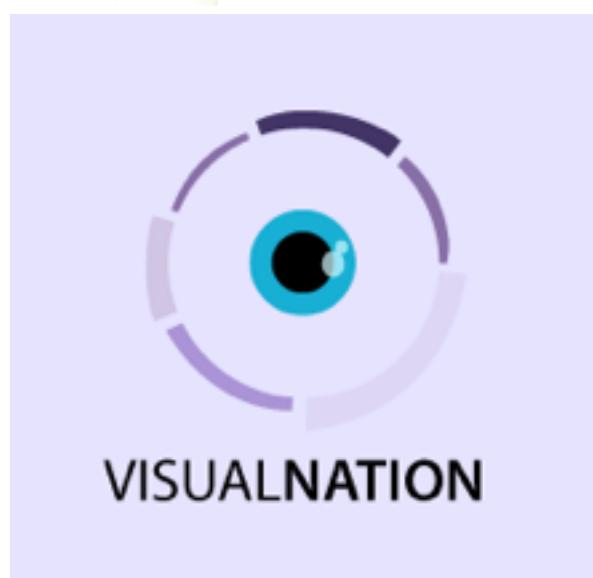
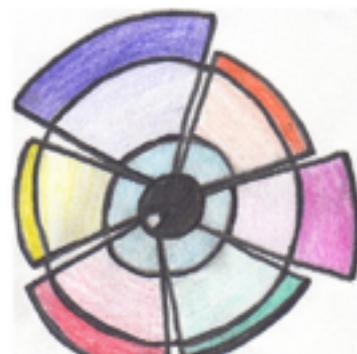
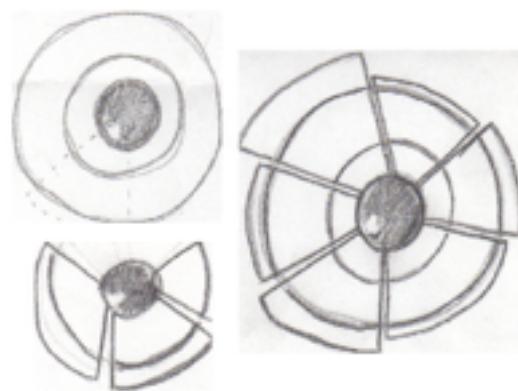
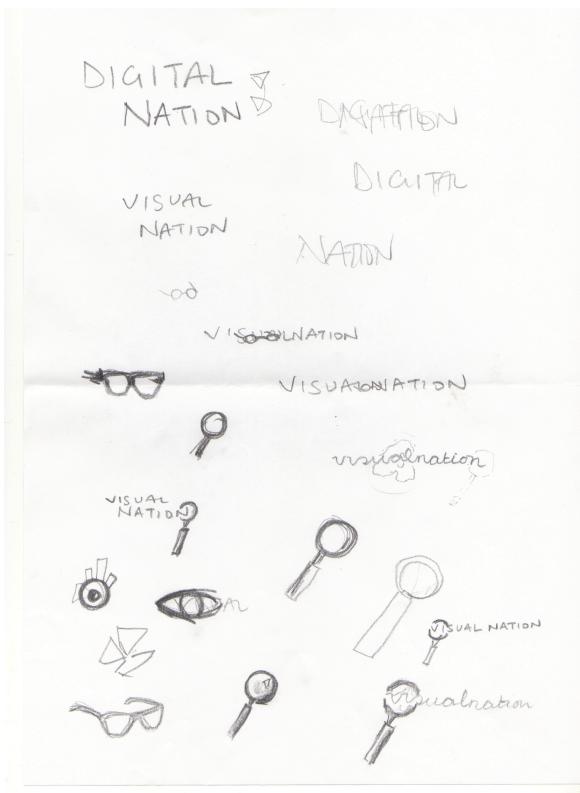
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# DIGITAL NATION



# DIGITAL NATION



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**W3C®** Markup Validation Service  
Check the markup (HTML, XHTML, ...) of Web documents

Jump To: Notes and Potential Issues Congratulations - Icons

This document was successfully checked as HTML5!

Result: Passed, 1 warning(s)

Address : <https://scm.ulster.ac.uk/~B00548156/workspace/mp/sitemap.html>

Encoding : utf-8

Doctype : HTML5

Root Element: html



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Address : <https://scm.ulster.ac.uk/~B00548156/workspace/mp/about.html>

Encoding : utf-8

Doctype : HTML5

Root Element: html



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Result: Passed, 1 warning(s)

Address: <https://scm.ulster.ac.uk/~B00548156/workspace/mp/contact.html>

Encoding: utf-8

Doctype: HTML5

Root Element: html



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## Markup Validation Service

Check the markup (HTML, XHTML, ...) of Web documents

Jump To: Notes and Potential Issues Congratulations - Icons

This document was successfully checked as HTML5!

Result: Passed, 1 warning(s)

Address: <https://scm.ulster.ac.uk/~B00548156/workspace/mp/disclaimer.html>

Encoding: utf-8

Doctype: HTML5

Root Element: html



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## User Survey

This survey is to gather your opinions on VisualNation. Please visit the site and interact with it. After please complete the questions below, rating each from 1 to 10, 1 being a low score (no/strongly disagree) and 10 being a high score (yes/strongly agree).

	Strongly Disagree										Strongly Agree
1. How clear is the <b>purpose</b> of the site?	1 2 3 4 5 6 7 8 9 10										
2. The <b>look and style</b> are appealing.	1 2 3 4 5 6 7 8 9 10										
3. The <b>colour scheme</b> is acceptable i.e neutral.	1 2 3 4 5 6 7 8 9 10										
4. The <b>navigation</b> clear and consistent throughout the site.	1 2 3 4 5 6 7 8 9 10										
5. It is easy to <b>select an area</b> to explore.	1 2 3 4 5 6 7 8 9 10										
6. The <b>map</b> is easy to interact with.	1 2 3 4 5 6 7 8 9 10										
7. <b>Information and statistics</b> are displayed clearly.	1 2 3 4 5 6 7 8 9 10										
8. The <b>accessibility</b> options clearly visible.	1 2 3 4 5 6 7 8 9 10										
9. Out of 10, please rate the ease of use.	1 2 3 4 5 6 7 8 9 10										
10. How likely would you be to use this site again/recommend to a friend?	1 2 3 4 5 6 7 8 9 10										
<i>• Map is good but if you could click on a different segment/area that would be even better .</i>											

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10. How likely would you be to use this site again/recommend to a friend?	1 2 3 4 5 6 7 8 9	10

General comments: Well laid out, to the point + precise.

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## User A.

### User Testing Task Sheet

#### Pre Task Questions:

- Do you use the internet often? Yes  No
- Would you find a website of this purpose useful? Yes  No
- Are you aware of any existing websites like this? Yes  No
- At first glance, what would you be likely to click on first? Yes  No
- Do you think the purpose of the site is clear? Yes  No

About

1. From the homepage navigate to the explore function. How did you get there?

Click on explore button.

2. Interact with the map. Can you zoom in to your area easily?

Yes

3. Select an area on the map to view. Are areas clearly marked? When this area is selected is there any other interaction on the page?

Areas clearly marked.

Tab with Town appears.

4. Toggle the layer on the map. Does this help to interpret the map easier?

Yes. Areas clearly defined.

5. Select an area from the drop down menu to the right of the map. What is displayed?

Pie charts with information about qualifications, Health and population of selected area.

6. Interact with the charts below the map. Are the titles clearly displayed? Do you have any difficulty interpreting these maps?

Titles very clearly displayed.

No difficulties interpreting results.

7. Select another area. Does the page respond to this without refreshing?

Selected Another area + page responded without refreshing.

User A.

8. Use the accessibility options to style the page to your needs. Are these easy to use? Do they help to make the site easier to interpret or are they not needed?

easy to use. Not needed.

9. Navigate to other pages on the site. Is there an option to get in contact? Can you navigate to the disclaimer easily?

Easily seen at bottom of page.  
Contact page easily navigated to.

Post Task Questions

- What is your overall opinion of the site?

Easy to use. Just right amount of information.

- What did you like about the site?

How you can divide map into local districts.

- What did you dislike about the site?

You cannot search for a town. only a drop down list of districts.

- What did you find easy to use?

The map + the different tools.

- What was difficult to use?

Hovering over pie charts for information - some of the pie charts segments very small.

- What would you change/ like to see incorporated?

Search tool to search for your town.

- Would you visit the site again?

Yes.

- Any other comments?

NO.

## User Testing Task Sheet

### Pre Task Questions:

- Do you use the internet often?  Yes  No
- Would you find a website of this purpose useful?  Yes  No
- Are you aware of any existing websites like this?  Yes  No
- At first glance, what would you be likely to click on first?  Yes  No EXPLORE
- Do you think the purpose of the site is clear?  Yes  No

1. From the homepage navigate to the explore function. How did you get there?

THROUGH TOP NAVIGATION BAR

2. Interact with the map. Can you zoom in to your area easily?

YES. USED BOTH MOUSE + CONTROLS

3. Select an area on the map to view. Are areas clearly marked? When this area is selected is there any other interaction on the page?

AREAS HAVE A MARKER, BUT MAP IS TOO BUSY - TOO MANY MARKERS.  
POPUPS  
ARE DISPLAYED

4. Toggle the layer on the map. Does this help to interpret the map easier?

YES, MAKES IT MUCH EASIER TO SEE MY AREA

5. Select an area from the drop down menu to the right of the map. What is displayed?

CHARTS AND AREA NAME ARE DISPLAYED

6. Interact with the charts below the map. Are the titles clearly displayed? Do you have any difficulty interpreting these maps?

TITLES ARE DISPLAYED, BUT COULD BE BIGGER  
CHARTS ARE EASY TO READ

7. Select another area. Does the page respond to this without refreshing?

CHARTS CHANGE. YES, IT DOES NOT NEED  
TO REFRESH.

8. Use the accessibility options to style the page to your needs. Are these easy to use? Do they help to make the site easier to interpret or are they not needed?

EASY TO USE, BUT MAKE LAYOUT STRANGE.  
EXTRA WORK NEEDED.

9. Navigate to other pages on the site. Is there an option to get in contact? Can you navigate to the disclaimer easily?

YES, CAN GET IN CONTACT. DISCLAIMER IS EASY TO SPOT.

#### Post Task Questions

- What is your overall opinion of the site?

PLEASING SITE, LOOKS GOOD, WORKS WELL, JUST NEEDS SLIGHT TWEAKING.

- What did you like about the site?

LIKED THE SIMPLE STYLE AND EASE OF USE.

- What did you dislike about the site?

CAN'T SEARCH FOR A SITE. COULD BE MORE INFORMATION ON OFFER.

- What did you find easy to use?

NAVIGATION, ACCESSIBILITY, SELECT FUNCTIONS

- What was difficult to use?

MAP LAYERS WEREN'T EASY TO SPOT

- What would you change/ like to see incorporated?

SEARCH FUNCTIONS, OR FILTER FUNCTIONS.

- ALSO, A GEO-LOCATION SERVICE WOULD BE GOOD.

- Would you visit the site again?

YES.

- Any other comments?

GOOD SITE. FUNCTIONS WELL BUT A SEARCH OPTION WOULD BE GOOD.