

Dissertation

by Cerys Jeanette Gibbins

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Interface Design for Mobile Devices Using PhoneGap

By

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Project submitted as part of the requirements for the award of
BSc (Hons) Web Development

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APPENDIX 1: DECLARATION FORM

DECLARATION

I, Cerys Jeanette Gibbins declare that I am the sole author of this project, that all references cited have been consulted, that I have conducted all work of which this is a record, and that the finished work lies within the prescribed word limits.

This work has not previously been accepted as part of any other degree submission.

Signed:

Date:

APPENDIX 2: FORM OF CONSENT

FORM OF CONSENT

I, Cerys Jeanette Gibbins hereby consent that my Project, submitted in candidature for the B.Sc. (Hons) Web Development degree, if successful, may be made available for inter-library loan or photocopying (subject of the law of copyright), and that the title and abstract may be made available to outside organisations.

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Date:

ABSTRACT

The proposed research will be focused on the project title "Interface Design for Mobile Devices Using PhoneGap". The aim of this project is to create an application that solves common usability factors in other applications. In order for it to function on a mobile platform, the developer will be exploring the web technology PhoneGap. The web technology PhoneGap will create the website into a mobile application. Overall, the project will be focused on comparing the different interface design features and testing which application has better usability results. Once the application is created, tried and tested it will be proven that the new application will be more user friendly and will possess the usability factors compared to the existing applications tested.

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CHAPTER 1: INTRODUCTION

The proposed research will be focused on the project title “Interface Design for Mobile Devices Using PhoneGap”. The aim of this project is to create an application that solves common usability factors in other applications. In order for it to function on a mobile platform, the developer will be exploring the web technology PhoneGap. The web technology PhoneGap will create the website into a mobile application. Overall, the project will be focused on comparing the different interface design features and testing which application has better usability results.

AIM

To investigate small screen designs that captures the attention of users by designing a suitable interface for a mobile device, by using the appropriate web technologies to demonstrate the outcome.

OBJECTIVES

- Researching the impact of small screen designs and how to construct an interface that allows users to access and navigate around the application easy.
- An understanding of research and working code will need to be tested so that the implementation meets the requirements.
- The reasoning of why the developer is building and constructing the application.
- Carrying out a usability study to measure how well people can use the application.
- Analysing the final results.

Mobile applications are important and relevant today as the mainstream of consumers have smartphones. Holzer and Ondrus[1] state

“...the development of mobile applications has generated more interest amount the independent and freelance developer community”.

The mobile application development has opened up many possibilities in the web technology to provide developers with technical and transferable skills that are needed across the web. Mobile applications are continuing to grow and are important because Kumar and Xie[2] recently mentioned

“Mobile computing enables user mobility as well as terminal mobility”.

Mobile computing is a worthy advantage because users are able to access their data via portable devices anytime and anywhere.

CHAPTER 2: RESEARCH & REVIEW OF LITERATURE

INTRODUCTION

During this chapter a literature review will be produced to discuss the relevant topics of the chosen project which is 'Interface Design for Mobile Devices Using PhoneGap'. By studying the relevant literature, it will give great understanding of how different factors will play a role in the development of using PhoneGap.

PHONEGAP OVERVIEW

The web technology that will be used to create the mobile application will be PhoneGap[3], it is considered to be the best one [4]. PhoneGaps framework uses native mobile applications, such as iPhone and Android which implements HTML, CSS and JavaScript languages. It can provide native features like the camera and media.

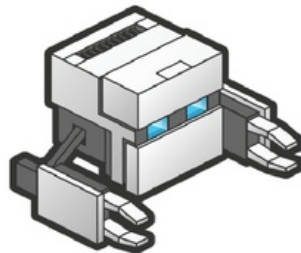


FIGURE 1 PHONEGAP SOFTWARE

HISTORY

PhoneGap is a popular mobile application that was originally generated by Nitobi[5]. The projects idea came from a hackathon in 2008 at the iPhoneDevCamp, now known as iOSDevCamp. After the hackathon the company Nitobi developed the software, located

in Vancouver, Canada. In 2011, Nitobi became part of Adobe to enable you to create applications for multiple devices using the same code [6]. PhoneGap started off with a web browser without a graphical user interface, referred to as a 'HeadlessBrowser' implementation for iPhone. A headless browser is automated to control web pages and are executed via a command line interface[7]. PhoneGap was implemented for the iPhone because of the popularity with the HTML, CSS and JavaScript technologies that developers were familiar with. However, after PhoneGaps popularity growing, Nitobi added support for Android and Blackberry devices [8].

HOW IT WORKS

PhoneGap is a web technology that allows a developer to create native applications for mobile devices by using web technologies [9]. When a developer creates an application, there are special tools that are provided by PhoneGap, they package the application into a native application for each of the supported mobile platforms. Below, is a figure illustration of a packaging process.

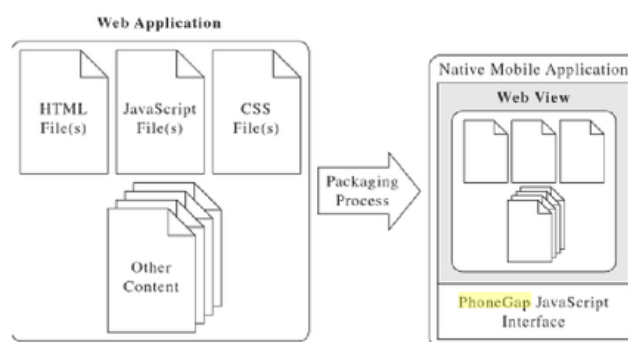


FIGURE 2 PHONEGAP APPLICATION ARCHITECTURE

Figure 2 above shows that within the native mobile application the user interface displays a single screen that contains nothing but a web view, which consumes all the

space that is available on the devices screen. When the application begins the launch it loads up the web applications start-up page into the web view which then passes the control to the web view to allow interaction between the user and the web application. While a user is interacting with the web application, JavaScript code will be able to load other content within the resource files that have been packaged with the application [9].

WHAT ARE PHONEGAPS FEATURES?

PhoneGap is a framework that is stable and is always evolving. These are some of the features that PhoneGap support and are available by calling native methods[10].

➤ Accelerometer

- The role of the Accelerometer feature is to detect when the user moves their phone, it is a listener that gets triggered when it is used [11]. The accelerometer is a built-in and is also capable of detecting rotation and motion gestures. A common use for the feature is to activate auto screen rotation on the mobile devices from when the user changes their orientation from portrait to landscape or vice-versa. Accelerometers are used in many different types of applications, for example to control the mobile device music player, gets utilised for enriching game controls. Another popular mobile phone based for accelerometer is turn-to-mute. This feature allows the user to mute an incoming call on their device, they can silent an alarm or pause the mobile music player by face the device down [12].

➤ Camera

- Mobile devices are featured with a camera feature which gives users the ability to use the digital camera to capture moments through photographs or videos. The most important characteristics of the camera features are the resolution

lens and the presence of a flash. The cameras resolution is measured in megapixels [13]. The camera feature is included and built-in a wide range of various devices, some include, iPhone, Blackberry and Android devices [14].

➤ Compass

- The Compass allows the PhoneGap program to determine the devices heading along a two-dimensional plan. This feature works similar to the accelerometer feature, the developers can query the devices orientation or set up a watch to have the API report orientation on a specific frequency or when the devices orientation changes by a minimum threshold. Most mobile devices have a compass built-in, and the API just simply queries the chip and returns an angel between 0 and 360 [9]. A compass being built-in within a mobile device is believed to be very useful as the application can tell you how far away a destination is from where you are standing.

➤ Media

- The media feature provides applications with the ability to record and play audio files on the mobile devices. This feature has limited capabilities and the documentation for the Media API starts off with a warning to the developers, reminding them that the API does not align with the W3C specification for the media capture. However, the media feature can still be useful to the users because the media feature provides a mechanism to play audio files which the capture feature does not provide. [9]

➤ Storage

- Nowadays, most HTML 5 browsers give web applications a capacity to read and write key qualities from and to a local storage facility in order to read and write information from and to a local SQL database [9].

➤ File Management

- Within the PhoneGap File API it offers an application with the methods that are needed to locate, read, copy, write, and remove files in the temporary and persistent file storage that is located on a mobile device [9]. When creating an application that allows you to create simple note-taking that uses the File API it is critical that you get the file management right. This is because users do not like it when an application gets corrupted and then loses the users data, so it is important that it is managed correctly. When managing it correctly has been accomplished then you can move on to make the application more complex. The note-taking application will not only be needed to save and load the notes, but to manage them as well [15].

➤ Contact List

- A source mentioned [16] : *"The contact object provides access to the device contacts database."*
- The contact API can create, store, search, copy and remove someone from a contact list. Every smartphone has a contacts database and it involves functions like *create()*, *save()*, *clone()*, *find()* and *remove()* [17] .

SUPPORTED PLATFORMS

PhoneGap currently supports the following operating systems for development:

- IOS, Windows Mobile, Android, webOS, BlackBerry, Windows Phone 7/8 and Symnian OS.

PHONEGAP GOOD?

PhoneGap is one of the most used technologies that developers use to create mobile applications. This section will underline the pros and cons of using this web technology with a conclusion to summarise whether if it is a good framework to use.

PROS

- PhoneGap helps your development to build interactive projects with web standards[18].
- All you need is HTML, CSS and JavaScript skills.
- Single, reusable code base that is for all platforms [19].
- You can take advantage and distribute your application on the App Store or Google Play etc.
- Having API components so you can access a tool, e.g. Camera.

CONS

- PhoneGap can have poor performance if your application is graphically intense.
- Even if you have coded an application using PhoneGap and it works on one device, it does not automatically mean that it is going to work on others. You will need to test and possibly make changes.
- Lack of pre-built UI widgets. This means that your development time could take longer.
- Can be difficult to get plugins that are current versions and all work well together.

- Documentation is not very descriptive and lacks information that is required for the development [18].

CONCLUSION

Overall, most developers believe that PhoneGap is one of the best web technologies because it helps your development to build the interactive projects you are aiming to achieve. PhoneGap is a growing technology which is being used to develop cross-mobile platform applications, this is an advantage because it saves developers time as they will not need to code for every platform device. Ghatol et al [20] once stated:

“...a developer with little or no native language background can start developing mobile applications...”

ALTERNATIVES

In web development there are popular web frameworks and technologies that are currently used to develop mobile applications. By having web frameworks in place they provide an easy-to-use programming model [21]. The frameworks help build and manage the web applications, services and websites. The frameworks help build and manage the web applications, services and websites. Some alternative frameworks and technologies that are identified and will help to develop a mobile application other than PhoneGap are [22] :

- Native Applications
- Hybrid Applications
- Appcelerator Titanium
- jQuery
- Sencha Touch

According to Rouse [23] Native Applications are stated in the context of mobile application because mobile applications have been written to work on a specific platform device and then get installed straight onto a mobile device. Developers can then create separate app versions for each mobile device. The developers like this advantage because their application will be able to be viewed on all platforms, however it can be time consuming and maybe frustrating for the developer. It will be frustrating for the developer because if changes needed to be made due to a bug or just general updating, then the developer will need to write that code for each specific and separate platform device which could take up time.

Native applications are known to be better for creating content because of the hardware and performance access that it has, whereas mobile web apps will be less suited for the content creation [24]. However, they have equally suited for the content consumption. There are three main mobile operating systems that native applications are written and developed for. These are Windows Phone, Apples IOS and Google's Android. To create accurate native applications Jobe[25] states

"Key characteristics of native applications are that these applications have unhindered access to device hardware and support all user interface and interaction..."

The pros of native apps are that they work with the devices in-built features which helps make it work easier and also perform faster on the device [26] .

MOBILE DEVICES

Mobile devices have become an essential part of everyday life as mobile now overtakes the desktop usage. The statistics of mobile phone usage is increasing rapidly and it is not the case of asking if mobile marketing is important anymore, we know it is. According to the ITU [27] the African market is increasing faster than any other market, establishing a 65% growth.

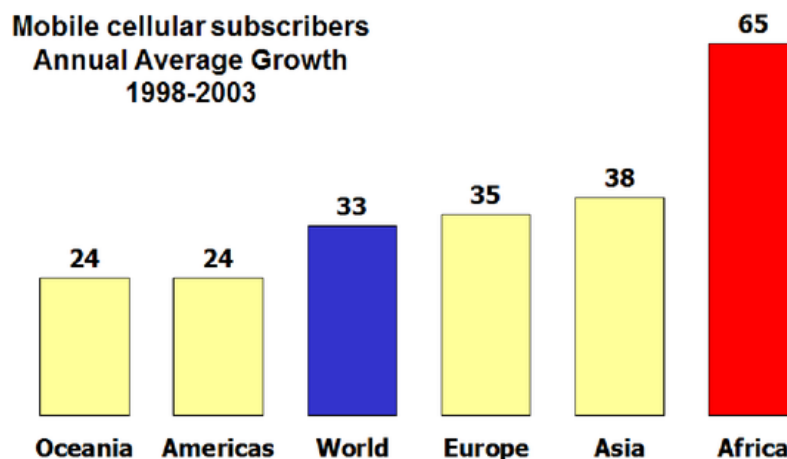


FIGURE 3 WORLD'S FASTEST GROWING MOBILE MARKET

Figure 3 shows what the annual average growth of mobile users that are using mobile phones and how it is increasing throughout the years in countries.

Jones and Marsden [28] describe mobile devices to be types of functions that allow you to organise your appointments and to-do lists, create multimedia messages and many more.

Mobile devices are being used in education for specific applications like M-learning[29]. According to Metcalf [30] :

"mLearning combines the technologies of mobile communications with "eLearning", which, for the purpose of this discussion, we can define as any form of electronically delivered learning material..."

It has been found that m-learning has more advantages compared to the electronic learning or the e-learning [31].

IMPACT OF SMALL SCREENS ON DESIGN

Currently, small screen devices are becoming more popular. The devices are so small that they are made easy to be portable and carry around, which allows users to access information wherever they go [32]. The impact of small screen designs is increasing and web developers are starting to be mobile first. Dillon et al [33] carried out a study and presented a journal article, talking about using a 20 and 60 line display window. The testers were requested to read the text and summarise their main points. After the experiment, the study found out that the comprehension rates on a small screen was as good as those on the larger. Dillon et al [33] found out that users reading from a small screen compared to a larger screen interacted with the display window to a higher standard.

INTERFACE DESIGN

The Interface Design brings together different concepts from the interaction design, visual and information architecture. The User Interface Design aspects are ensuring that the interface elements are easy to access, use and understand for users to carry out actions on what they need to do. There are multiple interface elements that users have become familiar with, so it is important that developers are consistent with their choices and layouts. In doing this, it will improve the satisfaction of the users [34].

When thinking about designing for the user experience it is known to ask questions. This is called Aesthetic Design, which determines how designers recognise good and bad product design [35]. The user experience design makes sure that the aesthetic and functional aspects of an element work in the context as supposed to. Garrett [35] mentions a questions that should be asked :

"Is the button too small for such an important function?"

These questions being asked are important for the user experience design because it makes sure that the button will be able to work in context with what the user is trying to do. Also, because websites and applications these days are being portrayed on hand held devices questions like these are relevant as the button would need to be big enough in order for the user to press it for the button to run its command.

As mentioned before user interface design should focus on the user's needs and expectations, not on what the developer thinks that look good. Having a successful User Interface design provides good usability, functionality and aesthetics to the outcome [36].

Interface Design is one of the most important concerns in the development of mobile applications. Mobile users are suffering from poor interface designs that hinder the usability of the mobile applications. The main problem in the interface design of mobile applications is caused by the unique features that mobile devices have. This includes the small screen size, insufficient data entry and low resolution. Thus, there is a need of guidelines for designing an effective and user-friendly interface for mobile devices [37].

In the article 'Interface Design for Mobile Applications' Adipat and Zhang [37] discuss a set of interface design guidelines and what should be taken into considerations when

designing interfaces for mobile applications. Nowadays, mobile phones have become very popular in carrying out business or normal routines. By having a mobile phone users are able to obtain information at any time in any location. However, applications are not all providing ease-of-use in the interface so a user will find it difficult in accomplishing a task.

In this study it has been recognised what problems mobile users are facing, these are [37] :

1. Limited memory of mobile devices
 - i. This issue can place a sort of burden on the user by making them trying to remember the meanings of the commands.
2. Information overload
 - i. This problem happens with the excessive overload of information that causes difficulty with finding the information because of small screens.
3. Navigation
 - i. The navigation issue with mobile applications causes confusion to the users on how to reach a path to a desired page. If the user is unaware on how to navigate through the application this will cause frustration and the user will not be that interested in using the application anymore.

These types of issues can make users feel hesitant on using mobile applications so it is important that developers design an effective interface for the users. Also, when designing for mobile platforms challenges will be encountered that the developer would not have thought of if designing for a larger screen.

Mobile devices have small screen sizes which do not offer that much space for developers to present information to the users [38]. The developer will need to strip down their big ideas and only interpret the most important features on the page, then either get rid of the rest of the information or bury it towards the end of the site.

As mentioned, user interface design focuses on awaiting what users might need to make sure that the interface has elements that have been implemented for easy access, understanding and how to use the elements that are in front of them. User Interface Design has different concepts from interaction design, visual design, and information architecture [34]. In the design concept there are different factors that will need to be considered in the process for the design of a successful user interface. The factors involved are development factors, visibility factors and acceptance factors. The development factors are to help with improving the visual communication that come from platform limitations, tool kits and such. Visibility factors take into considering the human factors are then portray a strong visual identity, such as human abilities and product identity. Lastly, there is the acceptance factors which involve international markets, training and documentation [39].

Interaction Design looks at creating and making an engaging interface with a lot of thought out behaviours. During this concept it is important that having an understanding on how users and technology can communicate with each other. This is because with this type of understanding, developers can visualise on how someone might interact with the application which will help fix problems early [40].

Visual Design will focus on the aesthetics of a site and the related material by strategically implementing colours, fonts and images. To create a successful visual

design it is crucial not to take away from the content on the page. Alternatively, it will enhance it by intriguing users and helping to build trust and interest [41].

According to a source [42],

"Information Architecture focuses on organising, structuring, and labelling content in an effective and sustainable way."

The goal for this concept is to help users locate information and complete tasks.

Nowadays, users are becoming more familiar with different types of interface elements acting in different ways, so developers have to become more consistent and predictable in their choices of when it comes to laying out and designing their websites or applications [34]. Also, when the developers are considering the appropriate elements for when they display the content they will need to think about what kind of difficulty on the user mentally they will portray. For instance, forcing them to guess what certain elements execute and might be.

A source has mentioned what interface elements include but are not limited to [34]:

- **Input Controls:** text fields, buttons, check boxes dropdown lists, date field. By having these controls in place such as the text fields will allows the users to input large amounts of information.
- **Navigational Components:** slider, search field, tags, breadcrumb. Having navigational components allow the users to find more information and navigate to related pages that are within a website or application.
- **Informational Components:** tooltips, icons, progress bard, notifications. These elements are useful for when messages and notifications are used for when the user needs to be notified about something.

- **Containers:** accordion. The containers hold sets of forms and elements, depending on the type of container, users will be able to move these around their screen in order to create better visibility [43].

In order to create the best practices in designing an interface it is best knowing your users and understanding what their goals are when using an application. When the developer has considered the following preferences from the user they will then go on to consider the following when designing an interface: [34]

- Making sure that the interface is kept simple as the best interfaces are invisible to the user. By avoiding using unnecessary elements and being clear in the language that is being used in messages and on labels.
- It is very important that the developer creates consistency and uses common user interface elements. Using the common user interface elements in the design will make the users feel more comfortable in using the application and will encourage them to undergo tasks more quickly. Also, it is important to create patterns in the layout and design throughout the application in order to meet the efficiency. When a user learns how to solve something and complete a task, they will be able to use that skill to complete other tasks on the application.
- When designing the interface the space between items on a page and the structure of the page should be considered as an importance. Making sure that items are placed in the correct placement to minimise the important information being missed.
- Intentionally using colour can help direct or redirect user's attention away from items that use colour to your advantage.

- Typography can help create hierarchy and clarity by using different sizes, fonts, colours and arrangements of the text to help with scalability, legibility and readability. Also, carefully considering the typography to make the information that is being read easy to see and understand. [34]

MOBILE DESIGN PATTERNS

There are three different kinds of design patterns, structural, creational and behavioural. The structural design pattern is how classes and objects can be collected to create larger structures [52]. The pattern also usually deals with the relationships between entities, which makes it easier for the entities to work together [50]. The structural pattern uses inheritance to compose objects that obtain a new functionality. Structural Design Pattern has many different patterns, the adapter, bridge, composite, façade, decorator and many others. Each of which have different objectives [51]. The creational patterns are designed to deal with the mechanisms which try to create objects in a manner that is suitable to a situation [53]. They get used when a decision is needed in creating an object of class [54]. There are six different types of creational design patterns, a few being, Factory Method Pattern, Abstract Factory Pattern and Singleton Pattern. The last pattern is Behavioural pattern and this is used in the communications between entities to make it easier and flexible for them to communicate [50]. Behavioural patterns are fretful to the responsibilities between the object or condensing behaviour in an object and delegating requests to it [55].

When developers, designers and product managers are deciding to create a mobile application they look for different various mobile design patterns. Different companies use a number of mobile patterns to define their mobile strategy; however it can be

difficult to find examples of the design best practices. It does not matter if you need to design an interface for a mobile or operating system, the patterns help developers and provide them with solutions to the design challenges [56]. There are two different types of navigation patterns, these are primary and secondary. The primary navigation pattern involves: Springboard, List Menu, Tab Menu, Gallery, Dashboard, Metaphor and Mega Menu. The secondary navigation patterns use: page carousels, image carousels and expanding list [56].

PRIMARY NAVIGATION PATTERNS

There are many different ways to navigate around a website or mobile application and to have good navigation is key because it makes it easy for users to accomplish tasks within the application. The primary navigation patterns will be discussed in detail [56].

Springboard

Figure 4The springboard pattern presents itself in a grid view for the users; it will be the main page of the application so the user can return back to the springboard. This type of pattern can work best for native applications as the screen size is small for those platforms [57]. The springboard pattern works well across the devices and is also sometimes referred to as a Launchpad. As mentioned, it is the landing page of the menu options so the users can navigation back and forth through the application from that menu [58].

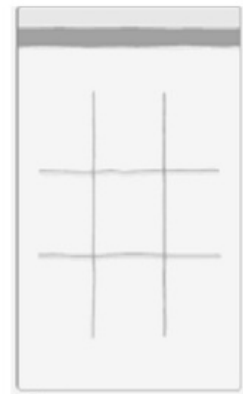


FIGURE 4
SPRINGBOARD MOBILE
PATTERN

List Menu

The list menu can be similar to the springboard as they are both the landing page for users going to one page onto another in the application. There are different variations of the list menu pattern, you can have personalised list menus, grouped lists or enhanced lists [56].



FIGURE 5 LIST MENU DESIGN PATTERN

Tabs

Neil stated [58] the tab navigation

"...is not OS neutral since each OS has their own guidelines for tab location and design. When choosing this pattern for your application, be prepared to customise the tab location for the different OS."

Having a horizontal bar that goes across the page, it contains different headings or categories of the application and website.

The navigation tabs provide a clear understanding of what content can be found on the application [59].

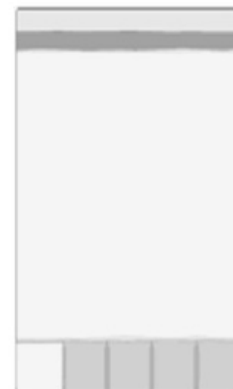


FIGURE 6 TAB MOBILE PATTERN

Gallery

The gallery pattern is when the content is usually images, articles, and products that are arranged in a carousel grid or a slideshow. Sometimes, users find this pattern easier because the information is grouped [56].



FIGURE 7 GALLERY
MOBILE PATTERN

Dashboard

The dashboard pattern allows you to define a primary navigation model. This pattern enables you to navigate between the different dashboards and navigate to external applications, navigate between the tabs in a dashboard [60]. The pattern provides a roll-up of key performances indicators. Each of the metrics will be drilled into to gather more additional information[58].



FIGURE 8 DASHBOARD MOBILE PATTERN

Metaphor

The metaphor pattern is usually used in games but can also be used in applications that help the user's categories items [58].

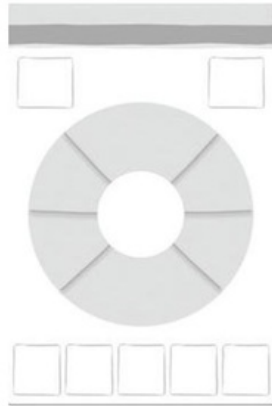


FIGURE 9 METAPHOR MOBILE PATTERN

Mega Menu

Lastly, the mega menu is a big overlay panel with custom of formatting and grouping of the menu options [58].

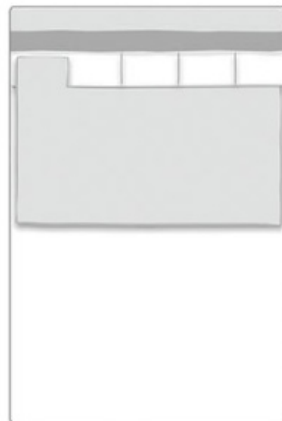


FIGURE 10 MEGA MENU MOBILE PATTERN

USABILITY FACTORS

Having usability factors in place before testing an application is important and they should be defined. Defining the factors is a responsibility for the developer because they need to know what kind of usability tests should be conducted on their application or product. Mandel[44] states:

"The product should be intuitive and easy to learn."

He mentions that this is not a clear objective to serve as a usability test. The factors need to be structured to contain information about specific performances or actions.

Booth [45] defines four factors that make up usability:

- Effectiveness
 - This factor will measure how successful the application is in allowing the user to perform a task.
- Learnability
 - How well users can use the application without much.
- Attitude
 - Making sure to implement something that will capture the user's perceptions and opinions on learning how to use the application. Users will then be satisfied.
- Usefulness
 - Enabling a user to achieve their goal.

Usability Testing is when you watch a user test out the application that you have built and do typical tasks, so the developer can detect and fix any issues that may confuse the user when using the application. Usability tests should be used throughout the whole process of an entire project. The reason for this are stated by Krug [46]:

- If you want a good site/application, you have got to test what you have built.
 - This is an important step because as a developer you would have been working on a project for weeks and you will not be able to see it as fresh anymore. The only way to make sure that your application or site is working correctly is by watching others using the application.
 - Carrying out tests will also remind the developer that not everyone thinks or does things the same way and use an application or website how you would. By getting them to carry out tests they will see and find issues with the site that you would not have come across yourself.
- Testing one user is better than testing none.
 - Testing always works and helps show you important issues that you can do to improve your application.
 - The tests do not need to last long, ten or fifteen minutes is enough time for a user to test and perform tasks on the application.
 - Having someone to test your application will help the developer with future savings on the project. This is because if a problem has been identified in the early stages then changes can be made which can result in saving time and money in the future to solve the issue.

- Carrying out a test on one user in the early stages of the project is better than gathering 20 different tests near the end of the project.
 - Having simple tests early on within a project is more valuable because you have the time to learn what you have done. However, carrying out a harder test near the end of the project, when you might not have enough time to make it sophisticated is not a good idea.

Now that smartphones and mobile applications are very popular it is important that usability tests are adopted for mobile applications as well as desktop. Small screens can be awkward to work with so having tests adopted will help test the different features like the keyboard and interface. In a recent paper, Ma et al [47] focus on usability testing for mobile applications. It is mentioned that usability testing in the laboratory can be costly for many mobile application developers. However, the developers suggest a toolkit for low-cost usability analysis that can be used. The toolkit is implemented in an Android based automatic usability toolkit. Ma et al [47] state:

"...the Android developer needs to modify the application source code by inserting statement calling out library, which captures UI events and uploads them to a central server."

The toolkit that has been created by the developers can effectively capture the usability problems within an application according to their results.

According to Gao et al [48] the term for mobile testing refers to

"...different types of testing, such as native mobile app testing, mobile device testing and mobile web app testing."

The different types of testing methods and tools ensure that the applications have good quality in their functions, mobility, usability and more.

In another study in 2007, Schusteritsch et al [49] wrote an article on “Towards the Perfect Infrastructure for Usability Testing on Mobile Devices”. In the paper, they describe different types of setups and tests that allow usability specialists to conduct their studies on mobile devices. Depending on what your project is on, different usability practices can be carried out on the mobile devices. The project will have many requirements to meet and some may change as the project progresses over time.

TASK ANALYSIS

Task Analysis is the method of understanding users observing them when undergoing actions to see how they perform the tasks that they have been given and whether if they can achieve their goals. The task analysis helps to identify the tasks that a website or application needs in order to help support and refine the navigation on the site by determining an appropriate content scope [61]. A task analysis has a wide range of techniques that are used by ergonomists, designers, operators and assessors that describe and evaluate the interaction in systems. Methods that get used in a task analysis will be documented as information and control facilities that were used to carry out the task [62].

Kirwan et al state [62]

“Task analysis is therefore a methodology which is supported by a number of specific techniques to help the analyst collect information, organise it and then use it...”

In a book Hackos and Redish [61] mention that performing a task analysis will help you understand many different points. Firstly, understanding what their users’ goals are and what they are hoping to achieve when using a website or application. The task analysis will help to determine what the users do to achieve their goals, to move onto what

experience the users may bring when performing a task. It is important to undergo the task analysis in the early stages of your project, even before the design stage. This is because the task analysis will help support any aspects of the user-centred design process [63]. When the task analysis has been complete there will be a lot of information, it is important that the analyst identifies the techniques and resources that they will use in order to validate the information [64].

There are several different types of task analysis but the most common ones that are used are [63]:

- Cognitive Task Analysis
- Hierarchical Task Analysis

The cognitive task analysis is question based where asking the user so the analyst can focus on understanding the tasks and solving problems [63]. Cognitive task analysis is the addition to task analysis techniques to get information about the knowledge and thought processes that users get when undergoing an observable task [65].

The Hierarchical task analysis focuses on decomposing a high-level task into subtasks [63]. The Hierarchical task analysis was first suggested in the 1960s to examine tasks. Since then, this has become a very wide adopted method [66] .

When it comes to conducting your task analysis it may involve several levels of investigation, going from general to very specific. When conducting the analysis it is best to decide which method will you be taking, the cognitive or the hierarchical task analysis. In this project the developer will be undergoing a cognitive analysis which allows them to talk to the user and get their response on what is best for the user [63].

Below is a list of steps that the developer will carry out when conducting their task analysis [63]:

1. The analyst will need to identify what tasks need to be analysed for them to gather the information that they need.
2. Identify what the user is trying to accomplish on the application by break a high-level task down into subtasks.
3. Gather the information to analyse to see if the results you wanted have been accomplished.
4. Present the analysis to someone who has not been involved in the project but understands and knows that the tasks enough to make sure that there was consistency.

Also, it is very important that the analyst knows what level of detail they will be going to divide the subtasks so they can make sure that they are consistent across the board [63]. When the analyst is identifying the tasks ready for the user to undergo, they could also ask the users what tasks they are trying to achieve and how they managed to accomplish the tasks, whether if they found it with ease or great difficulty.

ADVANTAGES AND DISADVANTAGES OF TASK ANALYSIS

Advantages

The advantages of a task analysis are:

- Find out what your application supports [63]
- Help you identify what is working well and what is not working well [67]

Disadvantages

- Task analysis requires time and resources that may not be in the planning [67]
- Can get caught up in something where more detail needs to be investigated [63]

CHAPTER 3: RESEARCH AND/OR DEVELOPMENT METHODOLOGY

INTRODUCTION

During this chapter a research and development methodology will be conducted to show what the developer will undergo during their project.

RESEARCH METHODOLOGY

For the proposed research approach the developer will be experiencing the project with a phenomenology philosophy as this accumulates information which is seen as natural rather than opposed to fake. A source once mentioned [68]

"...phenomenology studies ideas are generated from rick amount of data by the mean induction..."

The motivation behind why the developer has selected this reasoning over positivism is because phenomenology's points of interest exceed the advantages of positivism. Likewise, it looks into as a rule utilise the positivism theory for accurate information. Some favourable circumstances of the phenomenology are that it will help the developer to change in accordance with new issues and thoughts as they rise, help to contribute to the improvement of new thoughts that may come up. In any case, phenomenology additionally has its inconveniences. One disadvantage that it has is the gathering of data can take up a great deal of time and resources[68].

There is more than one approach to apply thinking, these incorporate deductive thinking and inductive. Deductive begins as a general explanation of theory and after

that gets separated into a conclusion based on evidence. As indicated by Klement [69] deductive is:

"...to provide a guarantee of the truth of the conclusion provided that the arguments premises are true."

Inductive reasoning begins with a little perception or observation and later on works out a theory by analysing the related issues. It is more of an exploratory than deductive. Bradford [70] states:

"Inductive reasoning makes broad generalisations from specific observations."

The developer will be utilising an inductive approach first starting off with the facts of the project and gradually assembling a conclusion. With an inductive approach the developer feels as if they will take in more and find significantly more things compared to deductive. Inductive gives you more of an interest and motivates you to get involved [71]. The disadvantages with the inductive approach it could disappoint the developer because if they cannot find the learning styles then they may rather be let it know. However, this is a good learning approach as it could better the developer to figure out how to find things out.

The strategies that will be completed involve a case study as when developing an application you will need to gather a variety of sources to investigate the topic. The choice of what web technology structure will be best to use by gathering and exploring the different advantages and disadvantages. McLeod [72] states that the strengths of carrying out a case study will provide rich qualitative information which will lead to an insight for further research.

Having a time horizon is essential as it relies on what extent a task will take and knowing this will enhance with completing the project on time. There are two distinctive types of time horizons, these are longitudinal and cross sectional. The project will be cross sectional in the fact that the developer does not have time to do a longitudinal study.

The information accumulation techniques are essential since it relies on how you are going to gather information and what methodologies will be utilised to get hold of the information. In order to analyse a professional and working mobile application the developer will need to assess the web technology that they are going to utilise so they have a comprehension of what the outcome will be.

Taking into consideration on what the reliability and validity of the developers methodology will include, reliability to check if it reliable to collect data from an experiment at a different time and if you would expect the get the same information. Validity is whether you are collecting the right information in the correct way. For instance, how you will be storing the feedback that will be received off people from the experiment.

The essential part of the research procedure is that the developer will need to use ethical issues by being honest about what they find, discover and then report. There will be bias acknowledgment so therefore the developer will need to be objective and do the work for integrity issues. Implying that if individuals take the survey and answer the questions, it is important to be honest about their answers and not bias the responses. The developer needs to be careful and conscientious of the work in what they do. When discovering what other people think the developer will need to respect it and reference what is said and not take their ideas. The key ethics that will need to be carried out are:

- Honesty
- Integrity
- Objectivity
- Carefulness
- Respect material goods

There will be legal issues in place to follow, as legal issues in computing are not broken.

There are different types of legal issues within the computer law. Some of these legal issues are:

- Data Protection / Privacy
- Intellectual Property – Copyright vs. Patents
- Computer Misuse Act

If these legal issues are not followed when carrying out a project then there will be risks. For example, if creating a mobile application that stores customer's data you will need to keep the customers data private so nobody can externally get hold of the information.

DEVELOPMENT METHODOLOGY

The development methods and techniques that will be utilised as a component of the projects development will be storyboards and prototypes. Storyboards will be intended to demonstrate the development of what the user interface will look like and will illustrate what the application will output. Making storyboards will allow the developer to show users or clients so they can get feedback, so the most important parts can be

recognised. If not recognised, the developer will need to adopt a better approach to make the important features to be recognised.

Some risks and limitations that could happen inside the project are that the developer might not be able to get hold of a piece of software that they will need in order for the developer to implement the mobile application. Might come across downtime because the computer system may go down, in the event that this happens then a recovery plan should be set up to find other tasks to do while attempting to fix the problem. Not being able to get access to enough of the target group, in order to deal with this it would be a good idea to promote the application to the target audience that you are aiming towards.

To dissect the information and evaluate the results of the project, completing distinctive sorts of tests will help compare with the user requirements of aims and objectives.

Carrying out software testing which will explore the quality of the application and the service that will be provided to the users. By experiencing user testing it will help to see if the user has any complications with the user interface so if they do, the developer will be able to get feedback and implement some new features.

CHAPTER 4: DESIGN & IMPLEMENTATION

INTRODUCTION

This chapter will include a deliverable of what the project will look like by producing frameworks and system designs. After the design section has been completed the implementation section will follow after where it will describe how the developer did the implementation and what tools and techniques they used.

EXISTING APPLICATIONS

Before carrying out the design of the project the developer looked at existing applications on how the interfaces were designed. This involved the developer to test participants by carrying out usability testing. The developer gathered ten participants, selected two different applications and wrote up different tasks for the participants to carry out on the applications. The results would show how the users would perform the tasks and if they were successful in finding the information they needed. The applications that were looked at were BBC Sport and eBay. These applications were chosen to see if the participants came across any issues in finding the information that they had been asked, in order for the developer to gather all the findings and analyse what the improvements should be to implement them into their personal project.

BBC SPORT

The BBC Sport mobile application is a guide for users to access information on their device when they want by finding out recent results on different sports. The mobile application provides users with the option to view headlines across a range of sports

and go deeper into the application by selecting links covering football, rugby, cricket, tennis and more. The sporting links can be customized to add and delete selected headlines covering from England, Scotland, Northern Ireland and Wales, meaning that the user can set alerts to be updated with news and results within these regions. However, despite having this function of being able to select regional options, finding the sporting news relevant to you, some users found it particularly hard and struggled to find any way to search for the options they needed. While carrying out the usability test questions with the participants, many limitations were mentioned about the mobile application.

Figure 11 shows the home page of the mobile application, it is a very basic homepage with some relevant information for the participants. Some of the information that they would try to find would draw them in to automatically go to the homepage to see if the information would be found there.



FIGURE 11 BBC SPORT APPLICATION

Tester 9 from Table 1 mentioned that when on the homepage and many other pages within the application the information was everywhere. The information that is being

displayed is not very clear to understand and some of it is irrelevant to the page that they are currently on. Also, by having a lot of information on the pages makes the user to have to scroll up and down through the page excessively. This being mentioned was found to be frustrating and encouraged the users to give up on looking and just scroll back to the top of the page. In order to solve this problem, the developer will cut down the amount of information that is being displayed on the page and will only display the relevant information that users will need. This will then no longer provide the users to continuously scrolling down for them to find what they need.

Figure 12 shows the navigation of the application and as you can see there is no contact tab available for users to get in contact with the BBC or the developer to ask a query if the users encounter a problem.

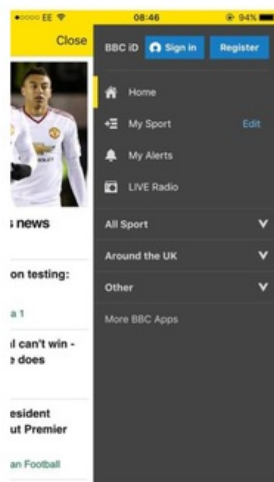


FIGURE 12 BBC SPORT NAVIGATION

During the usability testing the developer asked the participants to find contact details on the application and most of the participants found it very difficult to find. This is due to the application not stating a clear contact tab in order for users to find the information quickly. Instead, users had to waste time in scrolling through the whole application links in order to find the contact details and still some did not succeed in

discovering them. This is a poor usability factor because if users cannot find information that is known to be vitally important then they will leave the application frustrated and unhappy with the service that is supposedly being given to them. To improve this, Tester 4 and others from Table 1 suggested that by clearly displaying a contact tab like the other tabs would be more beneficial to them as it would make their experience a lot faster and easier. Also, this way will save the users from leaving the application and not having them to navigate to every link and scroll excessively to find the contact details.

Figure 13 shows an extended version of the navigation, which allows the users to select different sporting categories.

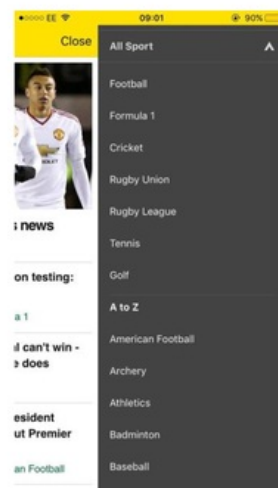


FIGURE 13 EXTENDED NAVIGATION

Overall, the BBC Sport application has more negatives than positives that have been identified by the participants. After gathering all the negatives of the application, the developer will be able to improve these within their application to make the application more usable for the participants and future users.

EBAY

The eBay application is an online market that was built to enable users and companies to sell items. The application allows for online auctions and for users to just buy an item straight away. Users are able to set refinements on their chosen product and then continue to proceed and buy the product. When the participants were undergoing the usability questions for eBay most of the users found eBay much easier to navigate around and find what they wanted. This shows that the design of the interface with eBay is much more usable and easier to understand, however participants did come across some problems as well when carrying out the usability test questions.

Figure 14 shows the home page of the mobile application and from this you can see that users are able to search for items, browse through the site by using the sliding navigation at the top and view their shopping basket. The homepage of the applications interface can be seen as very basic and dull in colour.

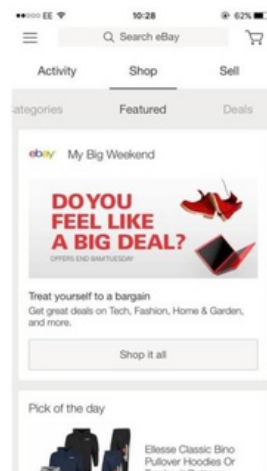


FIGURE 14 EBAY HOME APPLICATION

Figure 15 shows the navigation of the application, there are not that many pages for users to navigate to on this page and does not really indicate a proper navigation menu. By this, the user cannot search for categories in the application through this menu bar. However, there is a sliding menu on the home page in Figure 1 but many of the participants did not spot this.

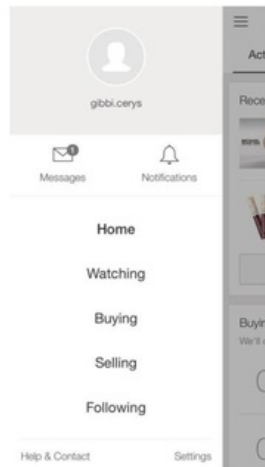


FIGURE 15 EBAY NAVIGATION

Figure 16 shows the users shopping basket, this page of the mobile application allows users to see what they have added to their basket, what they have saved and also allows them to remove items from their basket that they no longer want.

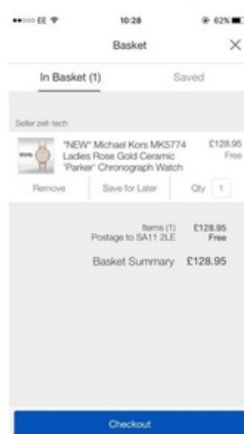


FIGURE 16 EBAY BASKET

FUTURE APPLICATION

After carrying out the usability testing on the existing application the developer then went on to creating paper prototypes of their application and designed the application to meet the testers recommendations that were suggested on the existing applications. The results showed that most of the testers had the same recommendation that the existing applications needed to improve on. Now that the developer gathered this information it assisted them to create a more usable and user friendly application. This is to allow the users to find information and carry out tasks more efficiently.

REQUIREMENTS

The purpose of building this application is to solve the interface design on an existing application after the developer has carried out usability testing. The new application will then give the user a fun and easy experience in learning different facts and events on sport. The user will be able to interact with all the different features and functions that are presented on the application. For example, submitting some feedback to the developer, contacting the developer for a query and finding out when their favourite football team play their next game.

The audience is aimed at anyone who has a mobile device and interested in keeping up to date with the news of different sporting events. The application has been built for all ages so it will not be confusing or complication for the different generation to navigate through the application or carry out tasks.

The significance of the application is to give information to the users on the recent sporting news, results and fixtures as this will allow them to take away the information and discuss it with others.

REQUIREMENTS CATALOGUE

The requirements catalogue will distinguish what the function and features are of each page within the new application the developer has implemented from the recommendations they received after carrying out the usability tests on the existing applications.

Home	Function: The home page function is to allow the user to navigate to the main page, which will show the recent news. Features: The features that the home page displays are the company's logo and name at the top left hand corner. This is so the user can understand what the application might be about. Also, news links that direct the user to another page for further detail on that news link.
Contact	Function: The function of the contact page is for the user to navigation around the application via the menu bar. Also, allow the user to get in contact with the developer. Features: A detailed query form so the user can fill out in order for the developer to get in contact with them or the user can directly email the developer.
Feedback	Function: The feedback page function is to allow the user to submit any feedback on the

	application so the developer knows if the application is how the user likes it or if they have recommendations. Features: The features include a text box so the user can give their feedback, along with a submit button.
Football	Function: The function of the football page is to allow users to catch up on any news they have missed out. Features: The page features a submenu to allow the user to navigate to different sections within the football category. For example, men, women, teams, gossip, tables and transfers.
Rugby	Function: The function of the rugby page is for the user to navigate around the application via the menu bar. Also, allow users to get the recent news in rugby. Features: The page features a submenu to allow the user to navigate to different sections within the rugby category. For example, rugby, union, league, table and teams.
Tennis	Function: The function of the tennis page is for the user to navigate around the application via the menu bar. Also, allow users to get the recent

	news in tennis. Features: The page features a submenu to allow the user to navigate to different sections within the tennis category. For example, men rankings and women rankings.
Boxing	Function: The function of the boxing page is for the user to navigate around the application via the menu bar. Also, allow users to get the recent news in boxing. Features: The page features a submenu to allow the user to navigate to different sections within the boxing category. For example, results and schedule and champion list.

DESIGN

This part of the document will include and illustrate the proposed structure of the application and how the pages link with one another by demonstrating a sitemap. Also, justifications of the pages layout and theme will be explained.

GANTT CHART

Before carrying out any part of the project, it is important that the developer knows what tasks they need to perform within a time limit. By creating yourself a Gantt chart it will set the developer tasks that they need to finish in certain duration of time.

		Task Mode ▾	Task Name ▾	Duration ▾	Start ▾	Finish ▾
1			Plan Action	5 days	Sun 04/10/15	Thu 08/10/15
2			Gather Existing Application	5 days	Fri 09/10/15	Thu 15/10/15
3			Write up Usability Test	2 days	Sat 16/01/16	Mon 18/01/16
4			Carry out Usability Test	10 days	Wed 10/02/16	Tue 23/02/16
5			Feedback	10 days	Wed 10/02/16	Tue 23/02/16
6			Analyse Feedback	2 days	Thu 25/02/16	Fri 26/02/16
7			User Requirements	1 day	Sat 27/02/16	Sat 27/02/16
8			Paper Prototypes	1 day	Sat 27/02/16	Sat 27/02/16
9			Feedback	1 day	Mon 29/02/16	Mon 29/02/16
10			Design	1 day	Wed 02/03/16	Wed 02/03/16
11			Get Software	1 day	Sun 04/10/15	Sun 04/10/15
12			Implement	21 days	Wed 02/03/16	Wed 30/03/16
13			Write up Usability Test	2 days	Thu 31/03/16	Fri 01/04/16
14			Carry out Usability Test	3 days	Thu 14/04/16	Mon 18/04/16
15			Feedback	2 days	Thu 14/04/16	Fri 15/04/16
16			Analyse Feedback	1 day	Sun 17/04/16	Sun 17/04/16
17			Make any changes	1 day	Tue 19/04/16	Tue 19/04/16
18			Produce Application	1 day	Wed 04/05/16	Wed 04/05/16

FIGURE 17 TASKS

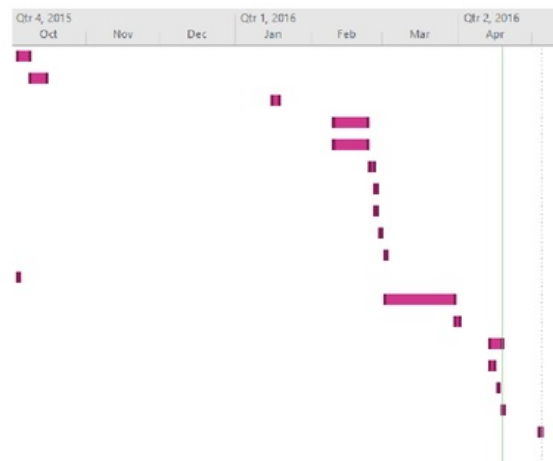


FIGURE 18 GANTT CHART

SITEMAP

Below is the proposed structure of the applications site map. This will show how the pages link to one another.

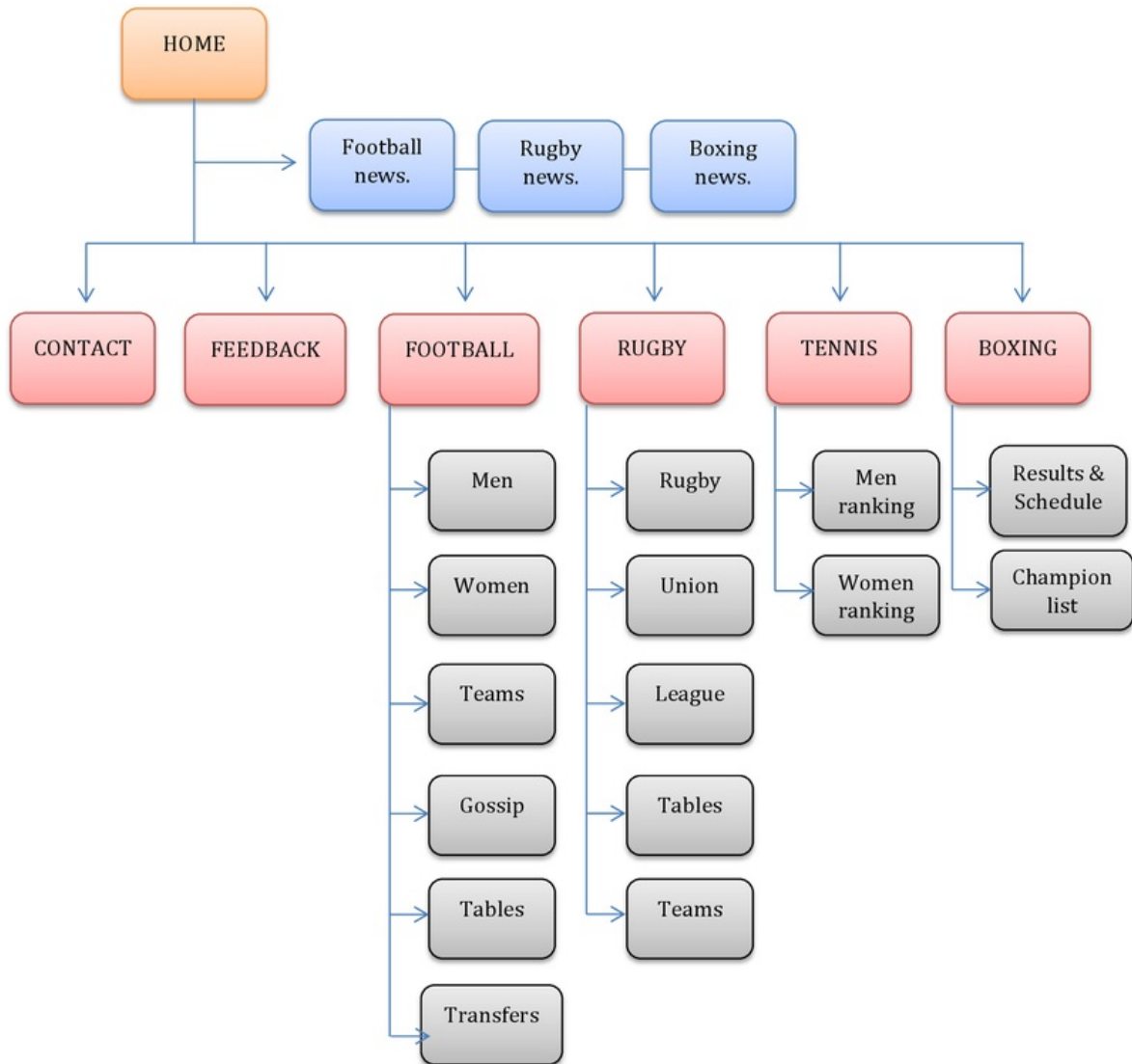


FIGURE 19 SITEMAP

The structure of the application is quite simple for users to navigate through, this will make the application very user friendly and functional. The user will view the homepage which will display three news links for the user to navigate to. Then when the user clicks the menu bar it will display the following links for the user to navigate to, which then allows the user to navigate sub menus to get more information for those pages.

PROTOTYPES

Below are prototypes of a few pages within the application that include their dimensions. Not all the paper prototypes were produced as they will all have the same structure as the 'Football' page.

HOME PAGE:

Below are images that show the paper prototype of the application along with the outcome of the design of the application.

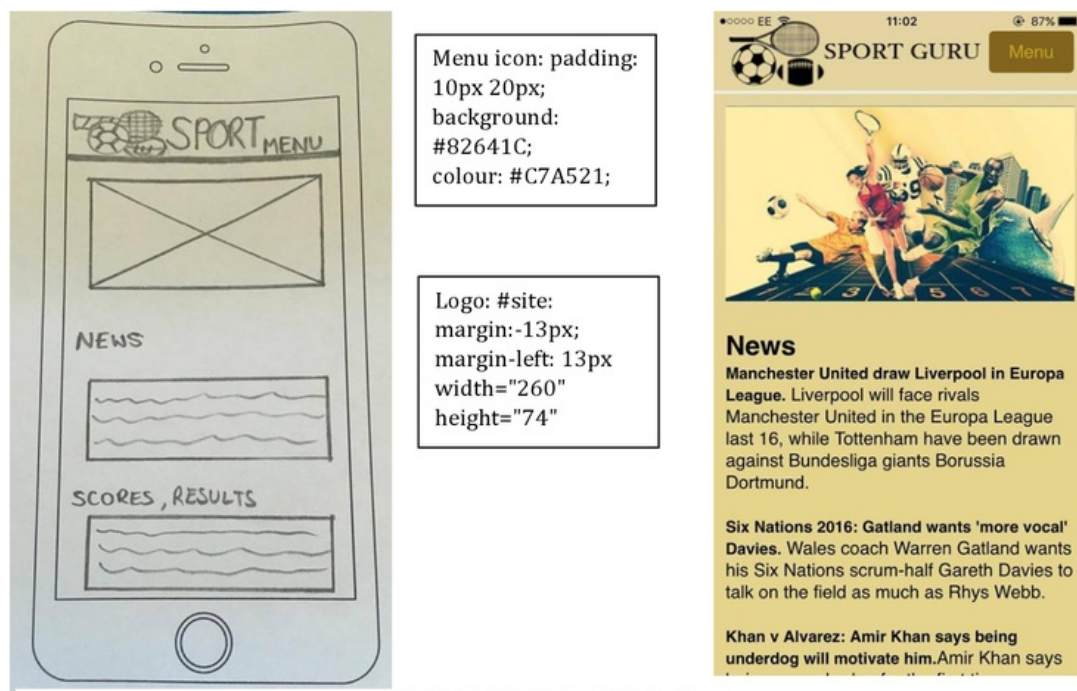


FIGURE 20 PROTOTYPE - HOMEPAGE

MENU:

The menu is a sliding out menu which appears from the left when the user clicks the 'menu' button.

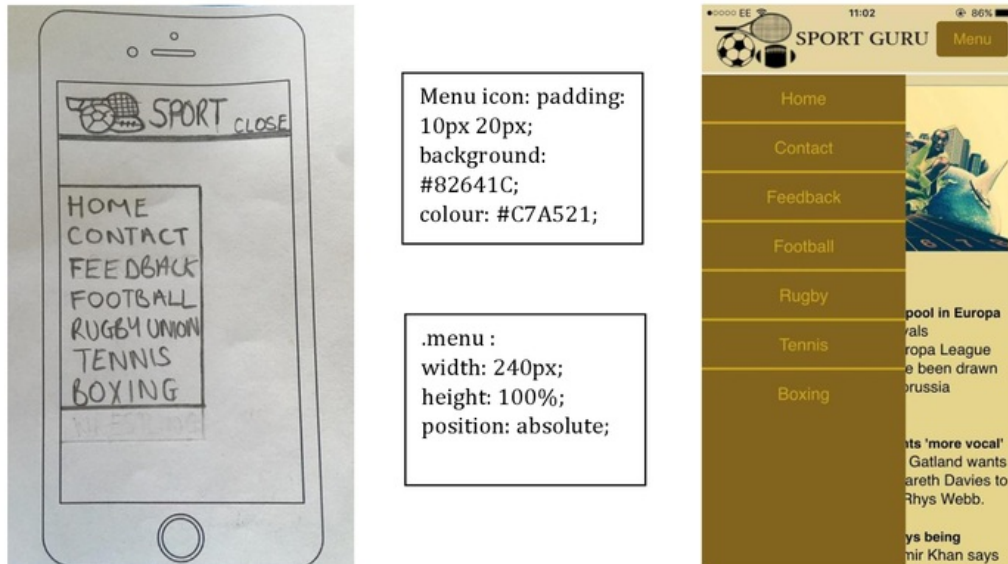


FIGURE 21 PAPER PROTOTYPE - MENU

CONTACT:

The contact page displays a form where the user can submit a query to the developer.

Also, there is a direct email that they can use to get in contact with the developer.

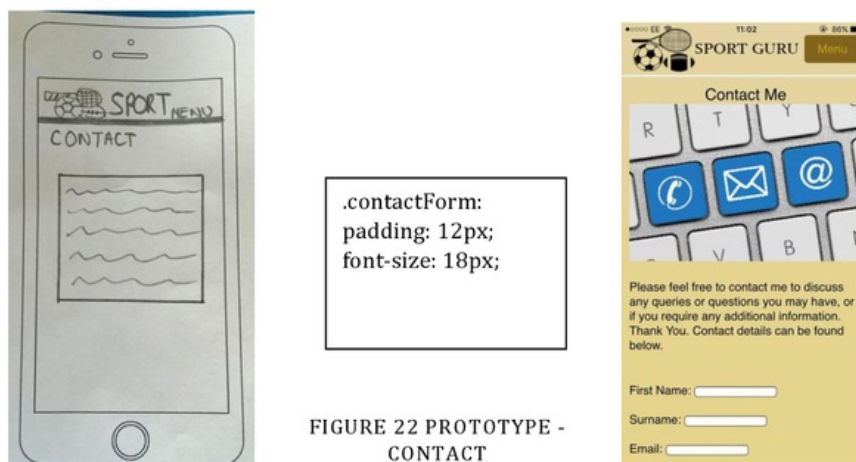


FIGURE 22 PROTOTYPE - CONTACT

FEEDBACK:

The feedback page allows the users to submit any additional information to the developer, the additional information could be based on something they like or dislike about the application.

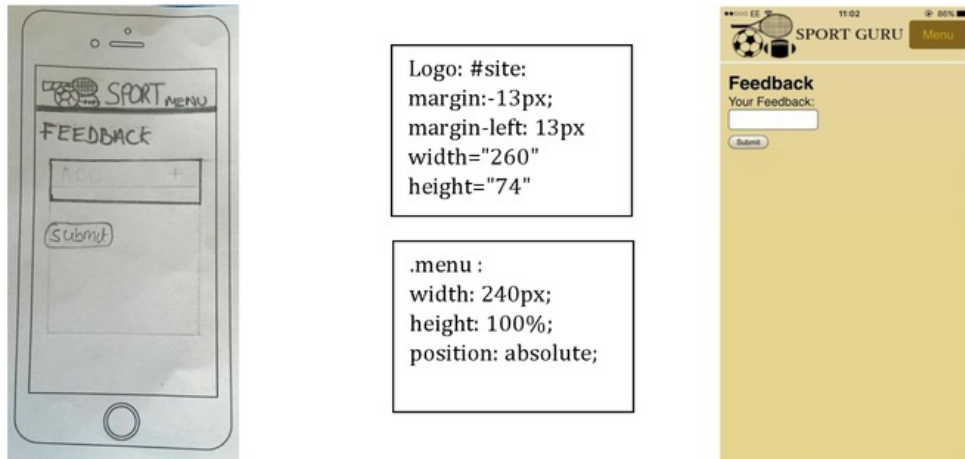


FIGURE 23 PROTOTYPE - FEEDBACK

FOOTBALL:

On the football page it presents the recent football news to the user, also allows the user to navigate to different categories by using the sub menu.

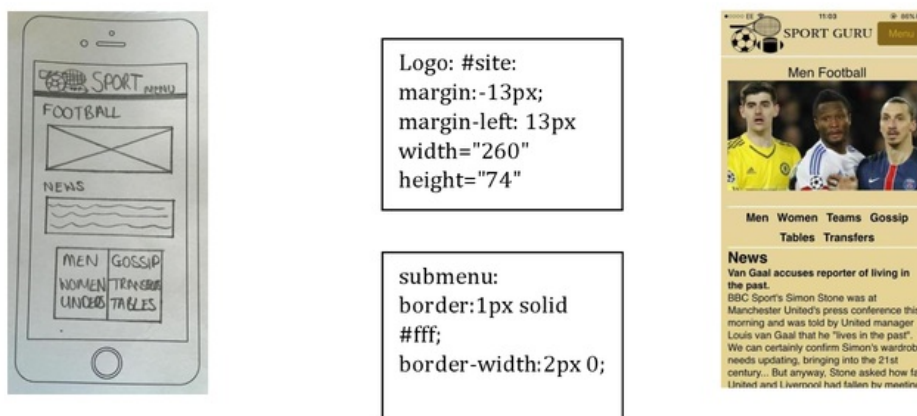


FIGURE 24 PROTOTYPE - FOOTBALL

PROCESS

When carrying out the design process of the project many decisions were made in order to solve the problems that the testers came across when using the existing applications. Before implementing the project the developer tried many different techniques for accessing the menu. This involved the developer testing the different mobile patterns and choosing which one the users thought was best. In order for them to have done this they created examples of many different mobile patterns ranging from springboard, tabs, mega menu and list menu. After creating the example snippets the developer gathered a few testers to ask their opinion on which pattern they preferred best. Later on, this steered the developer on deciding which mobile pattern they should apply for the menu bar.

The mobile pattern that the developer chose after the suggestions were given from the testers was the List Menu mobile pattern, with a sliding effect. The menu factor is the most important because if the users cannot understand how the navigation works then they will not be able to use the application effectively. Without a user friendly menu the application would not meet the usability requirements.

IMPLEMENTATION

The application has achieved the requirements of a usability study because the features that caused problems for the users in the existing applications have now been solved since the developer implemented their version of the application. The tools that were used to develop the application was PhoneGap as it was the main technology used in order for the developer to create the mobile application. The development libraries that were used to create the mobile application were HTML and CSS. The project was development and experiment based so the developer had to consider and encounter many tasks and decisions.

The project requirements were to build an application to solve the interface design on existing applications. The problems were discovered by carrying out usability tests on users, asking them to complete tasks. If they struggled carrying out a task they would want to move onto the next task. Some of the issues that arose while recording the users when undergoing the usability tasks were the excess amount of scrolling that they needed to do. Users found this very time consuming and an inconvenience in having to scroll up and down all the time to find the information they needed. The developer then made the decision to make it easier for the user to go straight back to the top of the page by creating a button instructing them to go 'Back to Top' in their new application.



FIGURE 25 BACK TO
TOP ICON

The application interfaces below all have different features and functions. The home page function is to allow the users to navigate to the main menu, which will show them the recent news. The news links are clickable which will direct the user to another page

within the application, discussing the news article in more depth. The features that are included on the home page involve the company logo which is displayed in the top left hand corner. The logo is hyperlinked so if the user is on another page in the application they can click the logo to be directed straight back to the home page. The menu bar is created as a list menu with a slide in and out effect, so when the user clicks the menu button the menu will appear from the left and come into the middle of the application. Here is a code snippet on how the menu bar was created.

```
<nav class="menu">
  <ul>
    <li><a href="index.html">Home</a></li>
    <li><a href="contact.html">Contact</a></li>
    <li><a href="news.html">News</a></li>
    <li><a href="feedback.html">Feedback</a></li>
    <li><a href="football.html">Football</a></li>
    <li><a href="rugby.html">Rugby</a></li>
    <li><a href="tennis.html">Tennis</a></li>
    <li><a href="boxing.html">Boxing</a></li>
  </ul>
</nav>

nav {
  width: 100%;
  text-align: center;
}

nav a {
  display: block;
  padding: 15px 0;
  border-bottom: 3px solid #C7A521;
}

nav a:hover {
  background: #B5ADA5;
  color: #FFF;
}

nav li:last-child a {
  border-bottom: none;
}

.menu {
  width: 240px;
  height: 100%;
  position: absolute;
  background: #82641C;
  left: -240px;
  transition: all .3s ease-in-out;
  -webkit-transition: all .3s ease-in-out;
  -moz-transition: all .3s ease-in-out;
}

.menu-icon {
  /*float: right;*/
  padding: 10px 20px;
  background: #82641C;
  color: #C7A521;
  font-size: 18px;
  cursor: pointer;
  margin-top: 20px;
  margin-right: 4px;
  border-radius: 5px;
  position: absolute;
  right: 10px;
  z-index: 3;
}
```

FIGURE 26 CODE SNIPPET

The contact page is an important page as one of the suggestions from many of the testers was that they could not find the contact details on the BBC Sport application. The application that the developer has created has made sure that the contact tab is one of the first ones so the user is aware of where they need to go to get in contact with someone. The features on the contact page display a detailed query form so the user can

fill out in order for the developer to get back in touch with the user. The user is also able to send a direct email to the developer, as they have hyperlinked their name to open up an email prompt.

The feedback page function is to allow the user to submit any feedback on the application, so the developer knows that the application is working to a satisfactory under the users' requirements. The users are also able to suggest any recommendation they wish in the feedback text box. The features required is a text box and a submit button to assist the user in entering their feedback and submitting it.

The function of the football page is to allow users to catch up on any news they have missed out. The page features a submenu to allow the user to navigate to different sections within the football category. For example, men, women, teams, gossip, tables and transfers.

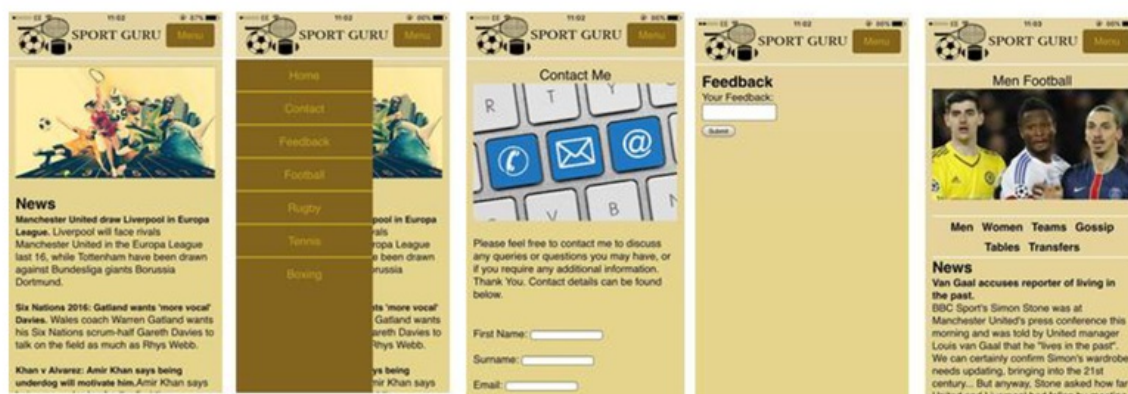


FIGURE 27 MOBILE APPLICATION DESIGNS

When carrying out the implementation of the application and creating the code the developer did not come across any problems in coding the software.

The testing of the software technique that was used was Usability Testing. The usability testing works when the developer watches and records a user testing out the application that has been built and undergoing tasks that have been written. This test is done so the developer can detect and fix any issues that may confuse the user when using the application. The usability tests were used throughout the whole process of this project.

For each experiment performed by the different testers the results came out majority of the same. Most of the users found the same common problems in the existing applications, the results in the new application created by the developer were mostly positive and users noticed the same results. The results that were gathered at the end of the experiments were what the developer expected, as they also carried out a usability test themselves and found the same issues that the testers did.

The issues that were identified by some testers was the existing applications interface elements were not familiar to them, this meant that they would not being able to carry out a task as they wished because they would not know what that element would do. In the research the developer found was that the user interface aspects are to ensure that the interface elements are easy to use. In this case the existing applications did not give this requirement to the users as some struggled to understand the elements and carry out actions on what they needed to do. From the developer gaining this information, they knew that when it came to creating their mobile application that they needed to be consistent with their choices and layouts as the research they carried out specifies.

Another issue linking back to the research found was information overload. This happens with the excessive overload of information that causes difficulty with users finding information because the screens are small. Most users identified that the existing applications have a lot of information within pages, some which is irrelevant to the page they are viewing. Also, users found this very time consuming and frustrating as they would need to do a lot of scrolling.

The navigation issue with the mobile applications also caused confusion to users on how to reach a path to a desired page. Some users were unaware of the submenu in the existing applications and were not clear on how to navigate through the application. This problem causes frustration and the user was no longer interested in carrying out a specific task anymore.

These issues that arose were all issues that the research stated what not to do if creating a mobile application. This is because issues like these make users feel hesitant on using the mobile applications. However, when the developer came to implementing their application they avoided these issues as the results from previous applications told them users were unhappy.

CHAPTER 4: RESULTS & ANALYSIS

INTRODUCTION

This chapter produces the usability questions, results and analysis of the design and implementation on both existing and future applications.

USABILITY QUESTIONS – EXISTING APPLICATION

The usability tasks that the developer asked the participants to complete are a listed below:

BBC SPORT

1. What were the results in the Wales vs. Ireland rugby match?
2. Create a notification, so you are up to date with Wales' rugby union.
3. If you wanted to contact someone. What are the contact details?
4. Navigate to a different page and navigate back to the home page.
5. Get information of when Swansea play their next football match.

EBAY

1. If you wanted to purchase a watch, how would you do it and add it to your basket?
2. Can you and are you able to view and remove items from your basket?
3. How do you get in contact with a seller on eBay?
4. How do you get in contact with eBay?
5. How do you view your feedback or a seller's feedback?

RESULTS FOR EXISTING APPLICATION

Below is a table of results based on the usability tests carried out on the existing applications.

Test Participant	Age	Date of Test	Application Tested
Tester 1	23	10/02/2016	BBC Sport eBay
Tester 2	20	10/02/2016	BBC Sport
Tester 3	24	10/02/2016	eBay
Tester 4	52	15/02/2016	BBC Sport eBay
Tester 5	56	15/02/2016	BBC Sport eBay
Tester 6	36	17/02/2016	BBC Sport eBay
Tester 7	17	17/02/2016	BBC Sport
Tester 8	11	17/02/2016	BBC Sport eBay
Tester 9	21	17/02/2016	BBC Sport
Tester 10	25	22/02/2016	BBC Sport

TABLE 1: EXISTING APPLICATION RESULTS

ANALYSIS

After following out a usability test on users, based on the design of interfaces in mobile applications many issues aroused. The developer has come across many problems on how some mobile applications are not designed to a high level of usability these days after observing test participants. The developer initially wanted to find out how usable the mobile applications were for all different age groups and if finding the information

the users wanted and needed was accessible and easy to find without any confusion or complexity. Both mobile applications had advantages and disadvantages in meeting the usability requirements for the users, some test participants struggled using the mobile application interfaces and would occasionally ask instructions on how to solve a problem. On the other hand, some test participants did not struggle in using the mobile interfaces as they became use to using them before the tests were carried out. However, the participants came across the same issues with both applications which identifies that the issue is a high disadvantage to the mobile application and should be improved to be more usable. Some tasks that were presented to the participants were easier than others and quicker to complete.

The sporting links on the BBC Sport application can be customized to add and delete selected headlines covering from England, Scotland, Northern Ireland and Wales, meaning that the user can set alerts to be updated with news and results within these regions. However, despite having this function of being able to select regional options, finding the sporting news relevant to you, some users found it particularly hard and struggled to find any way to search for the options they needed. While carrying out the usability test questions with the participants, many limitations were mentioned about the mobile application.

Tester 9 from Table 1 mentioned that when on the homepage and many other pages within the application the information was everywhere. The information that is being displayed is not very clear to understand and some of it is irrelevant to the page that they are currently on. Also, by having a lot of information on the pages makes the user to have to scroll up and down through the page excessively. This being mentioned was found to be frustrating and encouraged the users to give up on looking and just scroll

back to the top of the page. In order to solve this problem, the developer will cut down the amount of information that is being displayed on the page and will only display the relevant information that users will need. This will then no longer provide the users to continuously scrolling down for them to find what they need.

During the usability testing the developer asked the participants to find contact details on the application and most of the participants found it very difficult to find. This is due to the application not stating a clear contact tab in order for users to find the information quickly. Instead, users had to waste time in scrolling through the whole application links in order to find the contact details and still some did not succeed in discovering them. This is a poor usability factor because if users cannot find information that is known to be vitally important then they will leave the application frustrated and unhappy with the service that is supposedly being given to them. To improve this, Tester 4 and others from Table 1 suggested that by clearly displaying a contact tab like the other tabs would be more beneficial to them as it would make their experience a lot faster and easier. Also, this way will save the users from leaving the application and not having them to navigate to every link and scroll excessively to find the contact details.

Overall, the BBC Sport application has more negatives than positives that have been identified by the participants. After gathering all the negatives of the application, the developer will be able to improve these within their application to make the application more usable for the participants and future users.

Tester 10 suggested that having the pages in sections on the BBC Sport application so it is easier to read, sections like scores, teams and news so she is able to just click on what information she wants to know instead of it all being displayed on the homepage of football. The tester also mentioned that having another drop down menu on the

Football page is difficult to find. Another improvement that was suggested by most of the users is making the BBC Sport logo usable. So if a user is on a different page and would like to navigate back to the home page then they can simply click on the logo to be directed to the home page, instead of making extra clicks and wasting time by going through the menu bar. Tester 7 and Tester 8 also suggested by putting in a search bar in order for them to search their team instead of going through all the menus.

When the participants were undergoing the usability questions for eBay most of the users found eBay much easier to navigate around and find what they wanted. This shows that the design of the interface with eBay is much more usable and easier to understand, however participants did come across some problems as well when carrying out the usability test questions. All testers suggested that instead of having a drop down and displaying a question 'Ask Seller a question?' on the eBay application so that when you click on the seller's profile a contact button should be displayed clearly.

FUTURE APPLICATION

In order for the developer to solve the problems from the previous applications they needed to carry out a usability test on their application as well after implementing it. Below is a list of questions that were asked for the new mobile application.

USABILITY QUESTIONS

1. What were the results in the Ospreys vs. Leinster game?
2. Submit a review of your feedback on the application.
3. Navigate back to the homepage.
4. Can you get in contact with the owner or developer of the application?
5. When is Man United's next football match, against who and what time?
6. Who is the highest ranking male and female tennis players?

RESULTS FOR EXISTING APPLICATION

Below is a table of results based on the usability tests carried out on the existing applications.

Test Participant	Age	Date of Test	Application Tested
Tester 1	23	17/04/2016	Sport Guru
Tester 2	18	14/04/2016	Sport Guru
Tester 3	37	14/04/2016	Sport Guru
Tester 4	52	14/04/2016	Sport Guru
Tester 5	56	17/04/2016	Sport Guru

TABLE 2: FUTURE APPLICATION RESULTS

ANALYSIS

Carrying out a second usability test provided the developer with sufficient information in order for them to correct the mistakes in the previous applications. The developer wanted to find out how usable their application was compared to the other applications, to see if the design is to a high level of usability. The results that were established in the new application were very positive from all the different age groups of testers. The testers mentioned what they liked about the application and some also gave suggestions on how some features could be improved. The application had advantages and disadvantages in meeting the usability requirements for the users, one tester mentioned that on the football page for teams, the text colour should be altered. On the other hand, some test participants did not struggle in using the mobile interfaces and found it much easier to navigate compared to the other applications.

Tester 1 from Table 2 mentioned that on the sporting pages there should be another navigation link for 'Fixtures' and 'Results'. To show the users a day by day result on all the different teams that have played, as the tester believes it could be easier. The developer believes that this is a good suggestion as if the user knows a certain team has played on the day, they can find the information under the 'Results' link. This will save the user time as they will not need to search for that team and then scroll to find the information. Tester 4 from Table 2 mentioned many different requirements that they liked while using the mobile application. The tester stated and this application has solved the problems that were in the other application, before they struggled using the application because they could not find what they wanted without asking for some help or just giving up on the task. By having the submenu on some of the sporting pages made it easier for them to navigate to other sections of the sporting category. Whereas before they were unaware on how to access the submenu and did not realise that it was a function for them to use, which stopped them from finding the information that they wanted. It was more user friendly for the tester to get in contact with the developer of the application as they did not have to search excessively to find the details that they wanted. With that being mentioned, the tester went on to discuss that they noticed when scrolling down the pages of the application there was a sentence 'Back to Top' which would direct them straight to the top of the page, which they thought was an interesting feature as it saves them scrolling to the top.

The recommendations that were stated to improve the application were mostly some design features. Below the list includes:

- Use different styles of font to recognise the different headings.
- Have a background colour on the submenu to make it more noticeable.
- Background hover colour on the submenu text.

CHAPTER 5: EVALUATION

The conclusions that have been drawn from this data are that the application the developer has created has solved many of the usability requirements that lacked in the other applications. Users found using the newer application much easier and user friendly compared to the existing applications. The data that was gained from the results backed up the research that is covered in chapter 2. For example, the developer knew what it takes to create a usable mobile application so they knew they would need to be consistent with their choices. Whereas, from the results in the existing application did not meet all the usability requirements that was needed according to the research and the users results.

The objectives of the project have all been met, starting from an excess amount of research was carried out in order to find out what the impact of small screens were, how important interface design is and how it allows users to access and navigate the application easy. The others objectives that were met are:

- An understanding of research and working code that was tested so that the implementation meets the requirements.
- The reasoning of why the developer is building and constructing the application.
- Carrying out a usability study to measure how well people can use the application.
- Analysing the final results.

The aim of the project was to investigate the importance of interface design in small screens. This aim has been met as the developer discovered how important it was and then later on implemented the requirements into their application to meet usability

requirements and for it to be user friendly. It has been proven from the usability testing that the application has met the requirements to the users' needs.

Overall, in some ways the answers that were given were expected for all usability testing. However, if the developer was to do it again they would create and set more complex tasks for the users. This is because if the tasks are more complex and the user will manages to successfully carry out the application then the developer will know that the application is to a high level of usability. Also, by creating more complex tasks for the users it will give them the incentive to solve that task.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

The principal of this study was to determine interface designs for mobile devices using PhoneGap. The aim of the project was to create a mobile application that solves common usability factors in other applications. The research of the project focused on the different interface design features and usability testing techniques, in order to find out if applications had featured usability requirements. The research of the project was critical as the developer gained much strength in knowing what the advantages were and what the weaknesses were. If they did not undergo the research literature then the developer would not have known how to apply the information they learnt in order to create a user friendly and usable mobile application.

After finding out the research required for the project the developer carried out a research and development methodology. The research methodology involves what the developer will be experiencing within the project, they developer stated that they would approach the project with a phenomenology philosophy as this accumulates the information to be seen as natural as opposed to artificial. The development methods discussed which techniques will be used and they were storyboards and prototypes. The advantages of having prototypes are that the developer can test the prototypes on the users and can change features for the application before implementing if the users mention that they did not understand something on the paper prototype.

Now that the developer has gathered all the critical information they required, the design and implementation sections were carried out and the application was created. After the design and implementation was performed the developer needed to test and analyse their application to see if the usability requirements have been applied. The

results that were found were to be expected as the developer knew that some features could be improved.

The recommendations would be to create and set more complex tasks for the users. Also, adding more functionality into the mobile application by using JavaScript and creating notifications of when a favourite team plays their next game.

To conclude, the benefits that the developer has gained are that they know the importance of carrying out the research study of a topic their studying. Without gathering all the information they needed they would not have known what requirements were to be used in order to create a mobile application to meet the interface design requirements and the usability requirements.

CHAPTER 7: REFLECTION

On a personal and professional level the developer has benefited from doing this project. The research process that was required was extensive and included a lot of preparation and planning for each section of the study. This meant that each section of the study needed to be conducted and organised. At the beginning, the developer faced many challenges in the terms of finding numerous researches to back up their answers. They also struggled in keeping a plan with studying.

The developer did underestimate the duration of time that was required for the literature review and would be behind the schedule and was always told that they needed to work a little faster and write a lot more. However, this is a lesson that has been learnt and now the developer has dealt with adjusting a time plan for their study and creating a personal discipline if the task they have set has not been met. The research experienced has improved the developer's time-management skills which will be benefitted for personal and professional reasons.

While carrying out the project the developer has gained some self-confidence which has been overcome by communicating with tutors and talking openly to others about their project that they are undergoing.

Looking back on what the developer has done they seem to be happy with managing to complete a finished mobile application, presented with results. The developer has learnt that anything is possible if they continue to stick to it and believe in themselves. They have gained in believing in themselves which they lacked before beginning this project.

The developer has learnt that it is very important they all developers should do some research before implementing their website or mobile application, in order to gain user

requirements and that it takes to create a good, usable and user friendly website or mobile application.

Overall the developer believes that there is always room for improvement and if they had to improve on something they it would be to create and set more complex tasks for the users. Also, adding more functionality into the mobile application by using JavaScript and creating notifications of when a favourite team plays their next game.

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APPENDICES

INSTRUCTIONS

- For you to access the mobile application you will need to go to the 'My Computer' directory and click on the "DVD RW Drive, Project - App". This will direct you inside the folder and lead you to another folder called "SportApplication".
- Once you have done this step click on the "www" folder and you will be presented with many files. To go to the main homepage of the website, you will need to search for the file "index.html" and right click > "open with" > your chosen browser.
- After you have completed the following steps, the homepage will be displayed in the browser.
- To view the application as a mobile view, it is important that you set the developer tools in the browser to responsive view.