BSc (Hons) Computing Science

How can the features of web-based applications or native applications provide an improved experience for users booking travel tickets?

Baljinder Singh Dhanda

B00268829

23rd March 2018

Supervisor: Frances McCormick

Declaration

This dissertation is submitted in partial fulfilment of the requirements for the degree of Computing Science (Honours) in the University of the West of Scotland.

I declare that this dissertation embodies the results of my own work and that it has been composed by myself. Following normal academic conventions, I have made due acknowledgement to the work of others.

Name:

BALJINDER SINGH DHANDA

Signature:

Date:

Surname Dhanda
First Name Baljinder **Initials BSD**
Banner ID Number: B00268829
Course Code: COMPSCI
Course Description: Computing Science
Project Supervisor: Frances McCormick
Dissertation Title How can the features of web-based applications or native applications provide an improved experience for users booking travel tickets?
Academic Session: 2017/2018

COMPUTING HONOURS PROJECT SPECIFICATION FORM

Project Title:

How can the features of web-based applications or native applications provide an improved experience for users booking travel tickets?

Student:
Baljinder Singh Dhanda

Banner ID:
B00268829

Supervisor:
Frances McCormick

Moderator:
Miriam Birch

Outline of Project:

The purpose of this project is to find out how much a web-based application or a native application can be used to provide users with an increased experience on their mobile device in regards to the booking of travel flights. The research will be carried out in the development of each approach and detailing the benefits of each method to create the mobile applications. A comparison will also be carried out by creating two similar applications using web-based technologies such as HTML 5 and JQuery Mobile compared to using native based programming such as Java and XML to target an android device. Users will then carry out tests on the applications and will be given a survey detailing questions regarding their experience of the applications. The results will then be written up in the findings.

A Passable Project will:

1. Research the two approaches of native and web application programming in the creation of two mobile applications

2. Identifying the benefits and disadvantages of each approach when creating the mobile applications

3. Develop the two flight booking applications using native app programming and web-based application programming

4. Test each application using a user-based survey then evaluating the applications based on the results of the survey

5. Demonstrate a fair conclusion based on findings

A First-Class Project will:

1. Produce two strong prototypes for travel booking applications using the native and web-based application programming

2. Demonstrate a strong understanding of the two approaches to mobile development

3. Review the survey being carried out by a large number of people and analyse the data results

4. Provide critical analysis of the opinions people have given to the project and which approach is more effective in terms of usability

Reading List:

Amatya, S. and Kurti, A. (2017). Cross-Platform Mobile Development: Challenges and Opportunities pp. 219-229.

Charland, A. and Leroux, B. (2017). Mobile application development: web vs. native.

Dalmasso, I., Datta, S., Bonnet, C. and Nikaein, N. (2017). Survey, comparison and evaluation of cross platform mobile application development tools - IEEE Conference Publication.

Fling, B. (2010). Mobile design and development. Sebastopol, CA: O'Reilly Media.

Freeman, E. and Robson, E. (2011). *Head first HTML5 programming*. Sebastopol, CA: O'Reilly.

Heitkötter, H., Hanschke, S. and Majchrzak, T. (2017). Evaluating Cross-Platform Development Approaches for Mobile Applications pp. 120-138.

Ieeexplore.ieee.org. (2017). Mobile Web Apps - The Non-programmer's Alternative to Native Applications - IEEE Conference Publication.

Law, R. and Ngai, C. (2005). Usability of Travel Websites: A Case Study of the Perceptions
of Hong Kong Travelers. Journal of Hospitality & Leisure Marketing, 13(2), pp.19-31

Serrano, N., Hernantes, J. and Gallardo, G. (2017). Mobile Web Apps - IEEE Journals & Magazine.

Smutný, P. (2012). Mobile development tools and cross-platform solutions. Pp.653-656

Wasserman, A. (2017). Software engineering issues for mobile application development.

Xanthopoulos, S. and Xinogalos, S. (2017). A comparative analysis of cross-platform development approaches for mobile applications.

Resources Required:

A desktop computer containing the following software:

- WebStorm IDE
- Android Studio
- JQuery Mobile libraries

To view the Web-based application online follow this link**:**

http://travelflights.getforge.io/

Marking Scheme:

	Marks
Introduction	5
Literature Review	20
Primary Research	20
Prototype Development	20
Analysis of Research	20
Conclusion	10
Critical Self-Appraisal	5

Signed:

Student **Supervisor** **Moderator** **Year Leader**

IMPORTANT: ***By signing this form all signatories are confirming that any potential ethical issues have been considered and necessary actions undertaken and that Mark Stansfield (Module Coordinator) and Malcolm Crowe (Chair of School Ethics Committee) have been informed of any potential ethical issues relating to this proposed Hons Project.***

Table of Contents

Acknowledgements

One person, I would like to thank is Frances McCormick for all her guidance and support that she has provided me throughout my dissertation. She has also helped me throughout my entire university journey from first year to fourth year. She has provided me with a lot of knowledge and skills which I have implemented in this project and throughout many of my modules in university which I will never forget. She has always looked out for me and kept a keen interest in my progress throughout university especially in my honours year project ensuring that I achieve my goal.

The second person, I would like to thank is Miriam Birch for allowing me to take part in this computing science degree. She has given me a variety of knowledge in programming practises that I have implemented in this project. She has always offered to help me if I required any assistance and guided me to a possible solution. I am also very appreciative of the advice given to me regarding my interim report which I have used to help improve my final dissertation.

The third person, I would like to thank is Aman from Kohli Travel for taking time out of his busy work schedule to see me. I was very pleased with the feedback that Aman has provided me regarding my prototype applications and suggestions on how to make future improvements to the applications.

Finally, I would like to thank is Elaine from Barrhead travel for taking time out of her busy work schedule to see me. She provided me with very helpful advice regarding my prototype booking applications and suggestions to make improvements as well.

Abstract

The aim of this project is to find out how much more a web-based application or a native application can be used to provide users with an increased experience on their mobile device in regards to the booking of travel flights. The comparison will be carried out by creating two similar flight booking applications using the two technologies and comparing the results.

In order to carry out this project, background research will be carried out to find the typical features found in flight booking applications and the different technologies used to create both web-based and native applications. To build on top of the secondary research, primary research will be carried out in the form of surveys and interviews to gather people's opinions on the applications. This will help with the creation of the two prototype applications.

The prototype applications will then be tested by users to gather their thoughts on the user experience of the applications and which is better in terms of usability. The analysis will then be carried out on the results to draw a conclusion.

Introduction

The purpose of this project is to find out how much more a web-based application or a native application can be used to provide users with an increased experience on their mobile device in regards to the booking of travel flights. The comparison will be carried out by creating two similar flight booking applications using the two technologies and comparing the results.

Web-based applications are made up of typically three components HTML, CSS, and JavaScript. The HTML file defines the content creation of the application. For example, the text-based information shown on the application. The CSS (Cascading Style Sheets) defines the appearance of the application. The Javascript file controls the functionality of the application. Compared to native applications that use two main components. In this example, an Android application is being described as being created from an XML file and a Java file. The XML file defines the content of the application compared to the Java files that handle the functionality of the native application.

At the rate of which mobile applications have grown in the past, new technologies have arrived that make it simpler and easier to both create and use applications. This research aims to evaluate the difference between the traditional native programming of applications to the new approach of web applications in the creation of two mobile applications. Also, evaluating whether the newer approach is better, worse or the same when it comes to providing an easier user interface to purchase tickets.

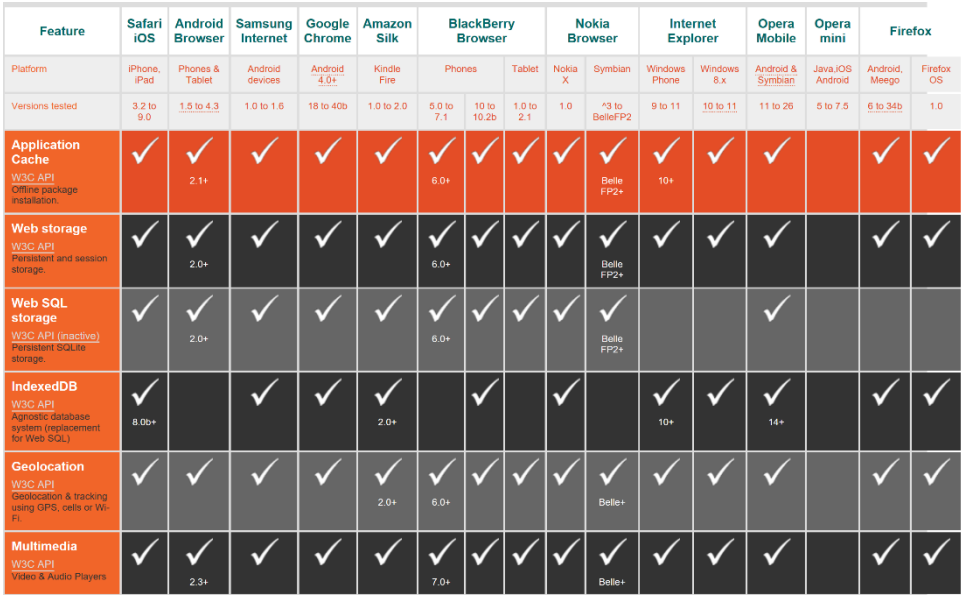
The aim of this particular research is to provide a better insight to the public of the great advancements in the technologies and how it helps users. The information gained from the insight of the Web applications and Native applications will be used to create a backbone to my final dissertation during the creation of the flight booking applications. The flight booking prototypes will be used to allow users to book travel tickets from various travel destinations and select various dates for booking. The research will also allow users to make an informed decision on the type of technology or languages to use to carry out a successful build.

Aims and Objectives of the project

- To show that web applications have a place in the current and future technology similar to native applications
- Identify the differences between Native and Web applications in the creation of mobile applications
- Developing two flight booking applications using native application programming and web application programming
- Test each application using a user-based survey then evaluating the applications based on the results of the survey
- Demonstrate a fair conclusion based on findings

Justification

The area of research was chosen because of the popularisation of HTML5 for support in mobile devices has increased throughout the years. This allows the content of information to be made widely available to many users, increasing the usability of web applications. Here is a list of some devices that are supported by HTML5.



Feature	Safari iOS	Android Browser	Samsung Internet	Google Chrome	Amazon Silk	BlackBerry Browser			Nokia Browser		Internet Explorer		Opera Mobile	Opera mini	Firefox	
Platform	iPhone, iPad	Phones & Tablet	Android devices	Android 4.0+	Kindle Fire	Phones		Tablet	Nokia X	Symbian	Windows Phone	Windows 8.x	Android & Symbian	Java,iOS Android	Android, Meego	Firefox OS
Versions tested	3.2 to 9.0	1.5 to 4.3	1.0 to 1.6	18 to 40b	1.0 to 2.0	5.0 to 7.1	10 to 10.2b	1.0 to 2.1	1.0	^3 to BelleFP2	9 to 11	10 to 11	11 to 26	5 to 7.5	6 to 34b	1.0
Application Cache W3C API Offline package installation.	✓	✓ 2.1+	✓	✓	✓	✓ 6.0+	✓	✓	✓	✓ Belle FP2+	✓ 10+	✓	✓		✓	✓
Web storage W3C API Persistent and session storage.	✓	✓ 2.0+	✓	✓	✓	✓ 6.0+	✓	✓	✓	✓ Belle FP2+	✓	✓	✓		✓	✓
Web SQL storage W3C API (inactive) Persistent SQLite storage.	✓	✓ 2.0+	✓	✓	✓	✓ 6.0+	✓	✓	✓	✓ Belle FP2+			✓			
IndexedDB W3C API Agnostic database system (replacement for Web SQL)	✓ 8.0b+		✓	✓	✓ 2.0+		✓		✓		✓ 10+	✓	✓ 14+		✓	✓
Geolocation W3C API Geolocation & tracking using GPS, cells or Wi-Fi.	✓	✓	✓	✓	✓ 2.0+	✓ 6.0+	✓	✓	✓	✓ Belle+	✓	✓	✓		✓	✓
Multimedia W3C API Video & Audio Players	✓	✓ 2.3+	✓	✓	✓	✓ 7.0+	✓	✓	✓	✓ Belle+	✓	✓	✓		✓	✓

HTML5 compatibility on mobile and tablet browsers with testing on real devices

Source: (mobilehtml5, 2015)

However native applications do also share a large population of the marketplace. This has been evident throughout the number of years developers have been creating native applications.

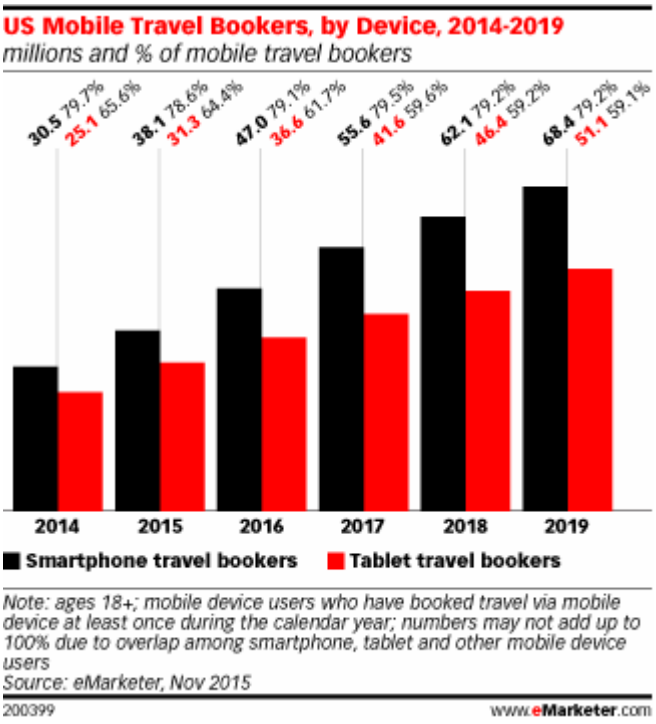
This research will be conducted to show the difference between native applications and web applications. Also, show which approach provides the ideal approach for users booking travel tickets.

Literature and Technical Review

The literature review is a significant part of the dissertation as it looks at various researcher's findings to analyse the patterns and developments of their research. A literature review builds the foundation of the researcher's work. It supports the researcher's findings and provides the researcher with a chance to find missing areas in the research. The topic of this document is very popular due to advancements in mobile application developments. The information relating to the document question was found through examining various journals, articles, books, and websites about the different technologies. The research found is related to the topic and is used to build upon the research in the same area.

Popularity of Travel Applications on Mobile Devices

There has been a growth in the number of people who book their travel tickets on their mobile devices over the years which has led to the increase in more mobile applications being built. eMarketer (2015) the percentage of mobile bookings of travel tickets is expected to rise each year starting from 30.5% in 2014 to rise to 68.4% in 2019 shown in the graph below. As a result of this growth, usability needs to be examined so that users can have the best experience possible on their mobile device. If this is not met users will no longer visit the application which will be a loss of revenue for the business.



Native Application

A native application is a piece of software that is installed directly onto the device hardware. This means that it is able to utilise specific hardware features that are implemented on that device such as mobile contacts, GPS and more. There are a number of different operating systems that native applications can be created for such as Apple IOS, Android, Windows and more. Native applications usually require a lot of space from the mobile device for the application to run. This can have an impact on users because of the limited storage space that is available on their mobile devices. This type of application is typically installed from a marketplace such as Google play store, Apple app store or Microsoft store.

Growth of Web-Based Applications

Web-based applications are a relatively new concept that did not officially start until the creation of HTML5. This brought about a change in the mobile application industry as HTML5 provided a method of allowing users to see content in a mobile-friendly manner. This is a result of HTML5 being cross-platform developed. An example of this is HTML5 microdata. This allows the content portion of a web page to broken down into different sections making it easier for the user to see and understand the text. Examples of these are the microdata header, footer, article and aside (Ronallo, 2012). In comparison to previous years where information was unstructured making it more difficult for people to understand information. This is an important part of the flight booking application to ensure that users can able to understand the content of the application allowing them to make the best decision when it comes to travelling.

HTML 5 Web Standard

HTML 5 is the fifth version of HTML that was developed into a standard by the W3 consortium in 2014. This had a massive impact on user experience for people browsing the web. HTML 5 has provided a wide range of new features such as new separation of content tags, new multimedia tags, new form elements and more (Weyl, 2013).

One example of the new multimedia tag that has been introduced within HTML5 is the video tag (Weyl, 2013). Before HTML 5 was introduced there was no fixed method displaying video content on browsers or mobile devices. It required users to download an external piece of software to view video content such as a flash player. However, this changed with the introduction of video tags as it allowed users to watch content without a flash player. Users are also able to set various attributes to the video such as defining video controls, autoplay features, looping and more. This made it a lot easier for users to watch video content on their devices.

HTML 5 APIs (Application Programmable Interfaces)

HTML 5 provides a range of features that help make it popular in mobile devices. This is through offering services such as web storage, embedding videos, web forms and more (Lubbers, Salim and Albers, 2011).

Web Storage API

Web storage offers the ability for users to store information on the client side of the browser to retrieve information faster compared to previously where a remote web server had to set up to store information (Lubbers, Salim and Albers, 2011). This meant that information had to be requested by the client from the server and sent back to the client over and over again. The key area in web storage that is useful for a web-based application is local storage. This is where information can be stored and retrieved through the using the setItem() and GetItem() functions in local storage. This information can also be stored even after the browser has been closed.

This can be implemented in the web-based application through saving the flight booking details that users enter into the application. Web Storage allows the user to close the application and save their current progress in the application.

Form API

HTML 5 provides a variety of web controls to deal with data input from users. This ensures that information is well structured making it easier for users to make web purchases, online discussions and effective searching of information (Lubbers, Salim and Albers, 2011). It offers the following data input types: text, email, telephone, date and more.

The key data input that would be used in the web-based application is the date. This allows the user to be presented with a graphical calendar making it easier for users to select dates for their flights. It also helps reduce human error which can occur if the user enters the date information as plain text. This also ensures that a valid date is chosen.

Types of Mobile Applications

Xanthopoulos and Xinogalos (2013) explain that there are five main types of mobile applications which are Native applications, Web applications, Hybrid applications, Interpreted applications and generated applications. But the main mobile applications that are going to be discussed below include Native, Web, and Hybrid applications.

Native applications are created using “integrated development environment (IDE) that provides the required tools for building and debugging the applications.” It also offers full access to the device hardware and data.

Web applications are browser-based applications from which the application is installed from the web. Web applications are created from internet technologies such as HTML and JavaScript. Using special libraries such as JQuery mobile will also help to simulate some of the functionality provided in a native application. The use of HTML5 is highly recommended as it has access to device hardware and software components through use of a number of Application Programmable Interfaces (API’s).

Hybrid applications are mainly built from HTML 5 and Javascript. This type of application embeds the HTML application inside a thin native container. This allows the application to be installed directly on the device and access the underline device hardware. An example of a popular container is PhoneGap.

XML – Executable Markup Language

XML is a markup language similar to HTML. XML is used to create the content of an application. In native applications specifically for Android, XML is used to create the design of the application. This is through the Android platform providing a vocabulary that connects the XML code to the corresponding layout and user interface of the application (Bin Aftab, Karim and Wajahat Karim., 2014). Some examples of layout tags that are used by XML are RelativeLayout and TextView. The RelativeLayout is used to keep elements of the screen to specific zones so that the information is kept concise. The TextView component is used to display text-based information to the screen of the application.

In Android Studio, the developer is also given a layout editor that builds the XML coding as the user drags and drops items to the emulator on the desktop screen such as text boxes, spinners, images and more (Editor, 2018). This helps the user interface to be developed at a faster rate and prevents human error through coding the wrong option for the device. But it also allows the buttons to be edited in XML to add a more precise location of the element on the device and to style the options further. Another feature that the layout editor allows is viewing the elements on the screen of the device as there are being selected so that the user can arrange the user interface, as they choose.

Android Data Storage

Android provides four main methods for storing the user's data. This is carried out through internal storage, external storage, shared preferences and a database (Developer.android.com, 2018). However, the main type of storage that will be looked at is shared preferences. This is an API that has been provided by Android to "read and write persistent key-value pairs of primitive data types such as booleans (true/false values), ints(numbers) and strings (text data)." This information is then connected to the XML coding that links each user input option to the variables. This basically allows the application to store the user's information even when the application has been exited.

Shared Preferences is useful especially in a flight booking application because the user may want to take their time thinking about other travel arrangements before confirming their booking with other people.

JQuery Mobile

JQuery Mobile is a full framework that is used to help with the creation of web-based applications for mobile devices. It is built on top of the libraries JQuery and JQuery user interface (Freeman, 2012).

JQuery Mobile works as soon as the library is attached to the application within a script element. JQuery Mobile scans the HTML document looking for elements that have a data-role attribute attached to them. The value of the attribute determines what type of change to make to the page nested inside the attribute. Various types of data-roles values can be applied to the application such as page, header, content, and footer (Freeman, 2012). A problem with JQuery Mobile is that a single HTML document is not able to have multiple pages. So, the developer must separate pages within the application with the use of the div elements and the data-role value “page” being applied to represent a page.

JQuery Mobile allows developers to customise the appearance of an application by using a ThemeRoller application. This is where ThemeRoller generates CSS to customise the web application (Freeman, 2012). However, ThemeRoller can be difficult to customise each individual aspect of a web-based application making it difficult to use. Also, it includes large amounts of CSS that is not required for the appearance of the application. As a result, it would be beneficial to just use CSS on its own to customise the web application.

Web Hosting

Web hosting is very important to ensure that the web-based application is able to run on different mobile devices. There are a variety of different web hosting services available which are shared web hosting, reseller web hosting, cloud-based web hosting, Virtual Private Server and dedicated web server. Each comes with its own benefits to using the servers (The Balance, 2018).

The cheapest option available to make use of in the web-based application would be shared web hosting service. This will allow the application to be viewed on any device and it's relatively cost-effective. An example of a shared web hosting website is getforge.

Getforge is a useful web hosting website as it provides a fast-static hosting of web-based applications (Forge, 2018). This means it allows the common HTML, CSS and Javascript files to be uploaded to the server which is found in web-based applications.

The hosting website also provides options that allow uploads of the web-based applications to be rolled back in case of problems with the live web page. It offers enough bandwidth on the free account for the flight booking system to run. However, it is not a reliable solution for multiple users in a real-world situation, as this space will be used up quickly depending on the number of users. For the prototype which is generally going to be no more than ten users at a time, it is a good solution. Although, the hosting website does allow users to purchase more bandwidth and additional packages to help with the future development.

Usability of a Web Application and Native Application

In order to create an excellent flight booking application using either native based programming or web-based programming. The first issue that needs to be investigated is usability. Usability is a term that basically describes how easily information can be extracted by the user. The information on a web application or a native application should allow for the user to be presented with useful information using minimum effort. This is similar to that of a website usability which is described next. Law (2005) had written a proposal of five main attributes that define a travel website's usability. These five attributes of website usability are made up of language, layout and graphics, information architecture, user interface and navigation, and general.

- The language attribute represents the text on the website being used to provide meaningful information to the user.
- The layout and graphics attribute represents the visual impact that the website gives to the user allowing them to decide whether or not to stay on the website.
- The information architecture deals with the overall build of the website and whether or not the information follows a key theme throughout it.
- The user interface and navigation attributes deal with the ability of the user to browse through the website and easily find what they are looking for with a few clicks of the mouse. This attribute above is considered the most important through reading various articles because if the user is unable to find what they are looking for with ease then the likelihood of them using the website again is zero. As a result, this feature will be considered carefully when designing the web and native-based flight booking applications.

- The general attribute finally represents the overall standards that should be maintained by a website. For example, ensuring that any issues with the website are fixed with maintenance e.g. a hyperlink that does not work on a website should be resolved.

From the attributes above regarding website usability, none of them sound unreasonable. The above attribute describes a web application/website. But the same attributes can be applied to the native application as well which will be investigated during the development of the applications.

Sin, Lawson, and Kannoorpatti (2012) explain the decision of creating a web application using HTML5, CSS3, and JQuery is very beneficial because it allows the application to be used on a wide range of devices and not targeted for a single device. This is very important as it will increase the number of people that can use the application dramatically. In comparison, a native application which is limited to a single device. But the native device has the ability to just fully focus on the targeted device ensuring that the user receives the best service available. However, if the application is required to be used on another device it requires further research into the different platforms which result in more time spent on the application design, implementation and cost of solving new problems that arise.

Current Flight Booking Web and Native based Applications

In order to design an effective and visually appealing web and native applications requires the gathering of the most common types of usable features implemented on these types of applications to build on it in the project. The applications that are going to be investigated are Kayak and EasyJet. There are many other web and native applications to examine regarding flight booking, but these have been chosen for the project as they exist in both native and web application forms.

An overall view of the applications is that both forms of native and web applications carry out the same goal at the end. Although each of the applications uses a different approach to gain the user's travel information. For example, the Kayak web and native application provide simplistic designs with fewer options that can be expanded if required, making it easy for the user to key in information. Compared to the EasyJet web and native application where the user is presented with too much information at the start. This can cause the user to become frustrated as some options do not apply to them at all. Refer to appendix 1, 2 and 3.

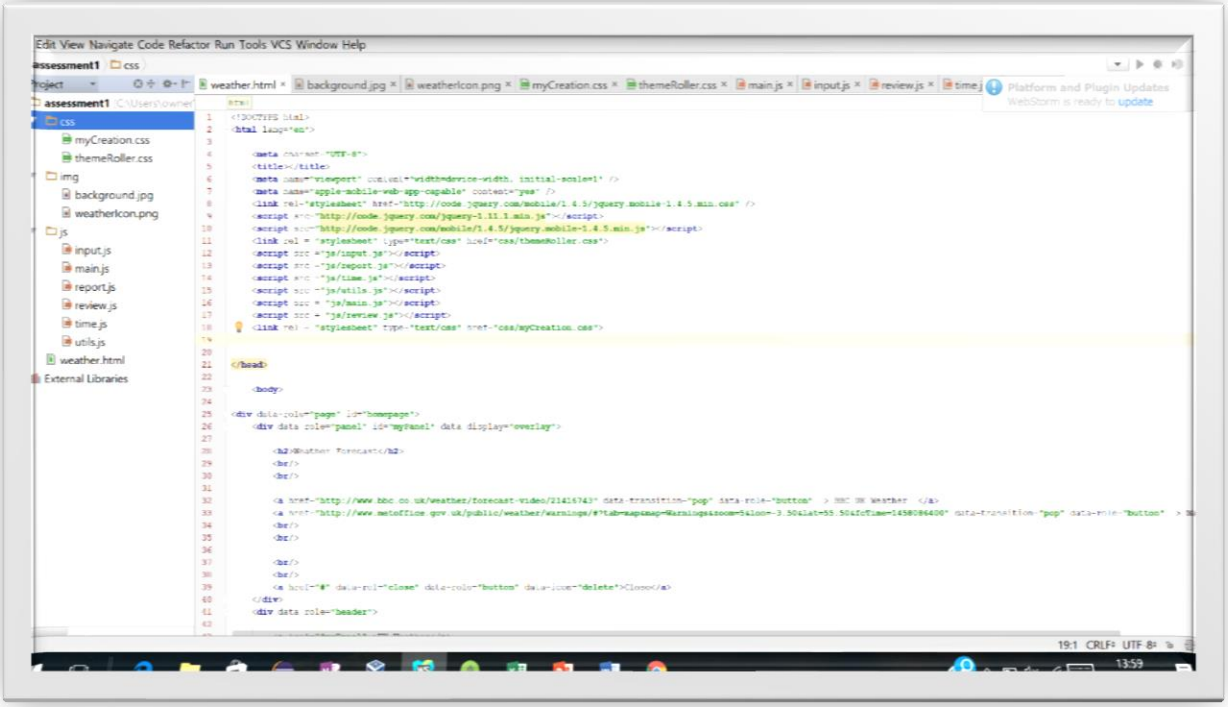
The second comparison is that the EasyJet web and native application just focuses on its own airline flights and does not look into alternative arrangements with other airlines. Whereas the Kayak web and native flight booking application compare airline prices to give people a choice of the cheapest flight. This is important because consumers are always looking for the best deal and in doing so will ensure that they return to the application for a future purchase. Refer to appendix 1, 2, 3 and 4.

The third comparison is that the EasyJet native application provides large text size making it easily readable for the user. Whereas the native application for Kayak uses smaller text size making it harder for the user to be able to select the correct flight or even be able to key in the correct destination. Refer to Appendix 2 and 3.

Technical Specification

In a comparison to showcase the best features of web applications, it will be written using HTML 5. Whereas the native application will be written using Java and XML. The programming language that will be used alongside HTML5 in the web application will be Javascript. The reason behind using Javascript is that it will add more functionality to the Web application. In addition, special libraries will be implemented on the web application written in Javascript called JQuery Mobile. This allows the web application to become more responsive and simplifies complex coding operations. For example, JQuery Mobile simplifies HTML document navigation on mobile devices, simplifies Ajax which is used for the scalability of the website to a mobile platform and simplifies Javascript coding (JQuery, 2017).

The web application will be created using WebStorm. This application will be very useful for creating the web application because it supports a list of the technologies such as HTML, CSS, and Javascript. These three technologies are the building blocks for any web application and ensure that an effective web application can be produced. The key advantages of using the WebStorm IDE is that it uses clever word association where it offers suggestions to make changes to the code that the user has written incorrectly. It provides the user with a graphical view of the file system structure so that users can easily find the files created for the application. This is very beneficial because writing any application involves the creation of a series of files and if there are grouped together it will ensure that the application runs smoothly.

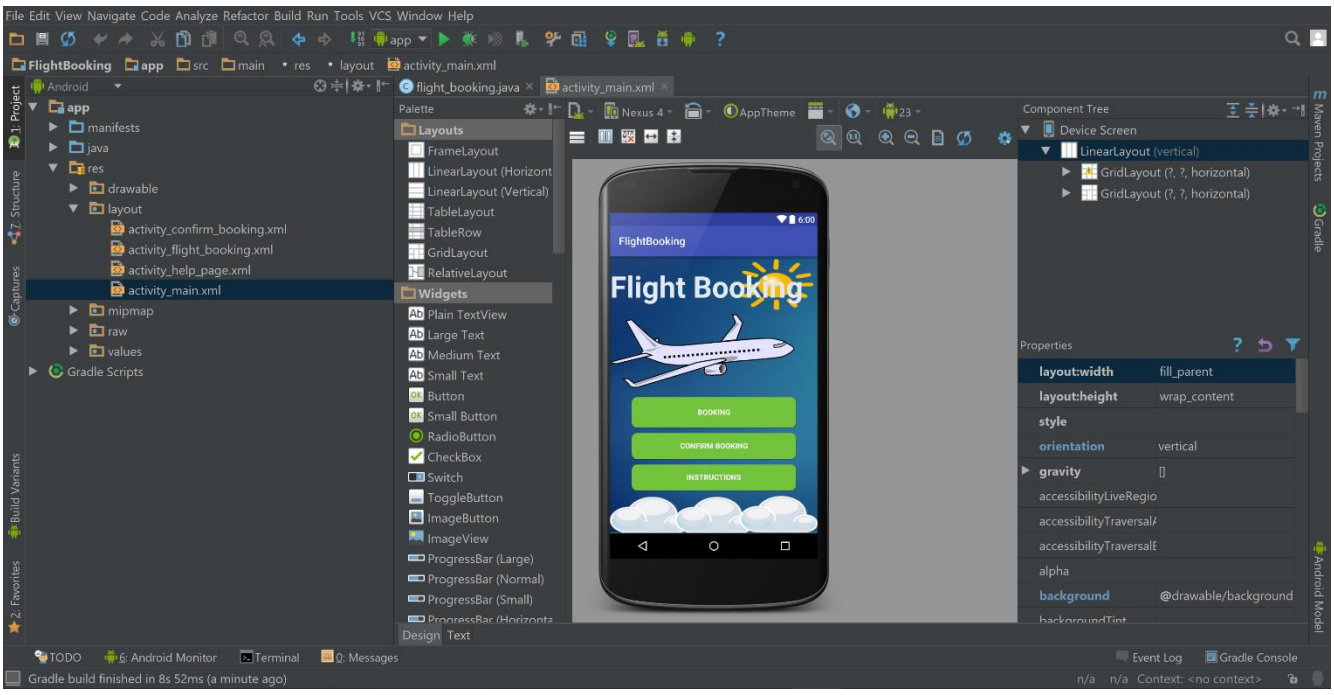


Webstorm 2017 11.0.3 Screenshot

The WebStorm application even supports future technology such as the frames Angular JS, React, Meteor and more. This is beneficial to the creation of the web application because it allows future enhancements to be carried out on the project. The WebStorm application is built in with a debugger. This is where the full application can be tested by the WebStorm IDE and checked for errors. It does this through testing each expression within the application by issuing a breakpoint at the end of the expression. This allows WebStorm IDE to see where up to the application works successfully and narrows down the problem. This is beneficial to the developer as it helps them to get the application up and running as soon as possible if a problem occurs (Webstorm, 2017).

The disadvantage of using WebStorm is that it requires a licence to be purchased for it to function. However, through the outline of benefits that are mentioned above. It is worth spending the money on the licence.

The native application will be created using Android Studio. This application is very useful for creating native applications for the Android platform because it provides a variety of customisation tools for application developers. This includes responsive code editing, debugging and testing functionality. The benefits of Android Studio are that it provides a fast emulator for users to carry out tests on the applications. This emulator is a very useful feature because it allows developers to test applications faster than a real device and it also allows the application to be tested on different Android compatible devices such as Android tablets, phones, or even smartwatches. Android Studio provides an easy to use layout editor. This allows users to drag and drop elements to the screen of the device for which the application is being developed to get an idea of the screen sizes and if the design is effective. Android Studio is a free to use application making it a viable choice for developers to create their applications.



Preliminary Work /Creative Accomplishments

In order to answer the question that was asked at the start of the dissertation, a large amount of research was carried out to come to a decision. This was carried out through creating working prototypes of the flight booking applications to gather the public's views about which application provides the best usability. This information was then recorded by the use of surveys. The prototypes were developed for users to simulate the process of booking a flight on their mobile device. This was through the user choosing: a destination, departure date, return date, number of people, airline and the price of the flight. Afterwards, the users would carry out tests on the applications allowing a wide range of opinions to be given on the applications. The beneficial factor of using surveys is that it ensures that a large number of people can be targeted giving the results a wide range of opinions. In addition, interviews were carried with local travel agents to get their feedback on the applications. The reason this was carried out is to get the response from employees who actually make use of the technology on a daily basis.

Research Methodology

For this project, the main focus will be using both Qualitative and Quantitative research approaches.

Qualitative research will be used through carrying out interviews and observational techniques to extract information from users about the applications. This will be carried out by allowing users to test both the web application and the native application to examine their reactions as a record is taken based on their live responses to the applications (Hughes, 2006). After the testing of the applications, users will be asked a variety of questions to gather more information about their thoughts on the applications and conclude which application provides effective usability for users.

Qualitative research is beneficial because this project involves a lot of emotions and face to face contact allowing users to openly express their attitude towards the applications.

Quantitative will also be used to carry out surveys to gain initial feedback from users about flight booking applications and a survey will be given to be each user during the testing stage to note down the user's experience of using the applications.

Project Development Approach

There are a variety of developmental approaches that are available to use each that come with their own specific techniques to carry out the project. Examples of these developmental approaches are prototyping, iterative and incremental development, the waterfall, and agile methods. The focus of this particular project will be making use of the prototyping development approach.

Prototyping is being used because this is a small-scale project being developed. Prototyping is beneficial to the development process as it ensures that the applications will be created quickly and allows for user feedback to carry out improvements on the applications.

Initial Survey

In order to reach a large number of people, a survey was created using Google Forms. This enabled multiple users to be questioned on their views on the topic of web-based compared to native applications and what features they look out for in a flight booking application. This information was then used to help the design process of the applications. This was an important process to carry out to ensure that users are being consulted as they are the primary reason for making the applications.

The target audience for the survey was the general public and students at the university. As a result, the questions were explained in detail within the survey so users who have no computing background are able to provide responses to the questions.

The type of questions asked in the survey was regarding the experience of using similar technology. For example, questions like methods of booking travel flights, the appearance of applications impacting decisions, types of features to look out for and more. A more in-depth description of the questions is shown throughout appendix five. The survey results were very good and the survey managed to get forty-two responses which are a wide range of opinions from users.

Initial Survey Results

The survey allowed for a variety of people to be targeted for responses to the dissertation topic and to find out people's opinions on the flight booking applications. The survey managed to get a lot of responses about forty-two in total.

In figure 5.0, when the users were asked about the type of method they prefer to book their flights. It was shown that almost 72% of participates found that the mobile platform has a larger impact on bookings compared to travel agent bookings. This shows that people usually prefer to book their tickets on their own compared to visiting a travel agent which a traditional approach.

An important question that was asked in figure 5.2 is whether or not the appearance of an application has an impact on the purchases of travel tickets. From the results, it is clear that nearly 67% of participates do feel that the applications should be functional and well designed to maintain customer satisfaction. This shows that usability does affect the booking of travel flights on mobile devices. However, there are still some users who do feel that it does have an impact at all in the overall booking process in an application.

As a result, the design of the mobile applications will be made aesthetically pleasing to prevent the loss of customers.

In figure 5.3, there was a variety of feedback given as to which features to include in a flight booking application. These features mainly included: creating a simple interface, adding a graphical calendar to insert dates, comparing prices and more.

Most of these features have been implemented in the two prototype applications. However, the comparison of prices has been included but because it is a prototype design, the comparison of prices is a fixed number for each airline and not a real value. This feature will be improved through future developments of the prototype.

Looking at figure 5.1, users had mixed opinions of whether or not to include videos and graphics to help with the booking process. Since more people agreed about including it. This feature will be included in the applications in the form of an Instructions page. This is where the user will be given a video walkthrough on how to carry out a booking using the application to help users with the task.

Prototype Development

Application Prototype Designs

In order to keep the design of the two mobile applications similar. A sketch was drawn using Microsoft PowerPoint to ensure that the applications do not end up looking completely different as shown in appendix six. From the research carried out in the literature review section of the report and the results of the initial survey. It has been shown that users are looking for a simplistic and easy to use application. This is why a simple and compact design has been created shown in appendix six. Essentially there will be three main pages in the prototypes which include a home page, booking page and a page to confirm the booking. On the home screen of the application, the user will be presented with two buttons to either add a booking or confirm a booking. If the user clicks to add a booking they are taken to another screen where they are presented with various options to insert flight information. Once this is completed users can then confirm their booking or edit the booking. An additional page will be included that provides a video walkthrough on how to use the applications.

Native Application

The plan was then implemented by first creating the home page in the native application. The advantage of using Android Studio IDE for the native application made it easier to view the positioning of objects on the screen thanks to the android emulator that matched the target screen size.

The difficulty came when aligning elements in the centre of the screen using XML in the booking page of the application. As moving one element on the screen resulted in the misalignment of another object. However, I managed to use the GridLayout class in Android Studio to place objects within a table format making it easier to manipulate the options.

Web Application

The web application was difficult to design for as well, due to the scaling down for the size of a mobile device. However, the use of JQuery Mobile made it easier to implement. As JQuery mobile does not change the HTML code but it enhances the code. This is carried out through the use of attributes known as data roles. The JQuery Mobile framework basically scans the HTML document and scales the document depending upon the value of the attribute.

Since designing a native-based application is made for a targeted device. There were some differences in which the applications handle the inputting of information in the booking page. This is a result of the native application being able to utilise hardware features found on the device. Some differences in the native application were the way in which the graphical calendar was represented to the user and the option buttons that were used to select a destination and number of people going on a flight.

Application Prototypes Functionality

The applications should be able to enter details that are provided by the user and provide the ability to make a booking.

This will be carried out in the web-based application through the use of HTML 5 Forms API. This allows users to enter in booking details through various input types such as date, text and select boxes.

Another benefit of using HTML 5 Forms is that it provides the user with automatic validation of the key features of the booking application which is entering dates. This information is then stored in an array to manipulate the details.

In contrast, the native application makes use of a series of edit text boxes and combo boxes to gather booking information for users. This process differs from the web-based application despite them carrying out the same functionality. The details are then stored into various arrays and variables to manipulate the data.

The applications should be able to save data in case the user wants to take their time before confirming a booking.

This is carried out in the web-based application through the use of HTML Web Storage API. This allows the client to store the information that the user has inserted into the various options in the application. This information is then stored and retrieved from web storage using the setItem() and getItem() functions in local storage.

To save the user's information within the native application. It requires the information to be saved using the SharedPreferences API in android. This allows the application to read and manipulate the data that the user has written in the various input fields.

Prototype Testing

It was important to test each application to ensure that no problems exist at each stage of the development. This was carried out to avoid a mass number of errors occurring at the one time slowing the entire project down.

The method that was used to test the web-based application was making use of the Chrome Browser developer tools (Developer.chrome.com, 2018). This provided a method of displaying the web-based application on different devices to test that the application performed similarly on different platforms. It also provided a valuable console tool for debugging the application. This involved continuously checking the console to ensure no errors existed. If an error was found within the console, it provided an excellent approach of finding the location of the error in the application by indicating which line in the files had the error (Developer.chrome.com, 2018). It also provided the user with a description of the problem. This allowed the problem to be identified and a solution put in place to fix the issue.

Another method of testing the web-based application before problems occurred is a unique feature that is provided by WebStorm known as “on-the-fly error detection.” This is where the IDE would check the coding used in the web-based application to make sure it was correct. It also provides access to other inspection tools such as JSHint, JSLint, JSCS (Javascript code style checker) and more (Jetbrains.com, 2018).

The method that was used to test the native application for programming errors was using Android Studio’s debugger. This was used to further investigate problems with the application. The debugger uses a series of “breakpoints” which are basically markers to indicate the point up to where the application was working to help narrow down the problem (App, 2018). This ensured that the problem was fixed as soon as possible. Android Studio also offers a unique hint feature to help developers fix the code by highlighting some problem areas of code in red and offering suggestions to help resolve problems.

Hosting

The native application will be installed directly onto the targeted device which is an Android Samsung Galaxy S7 edge. This is carried out through the functionality provided by Android studio which allows USB debugging to be initiated. This allows the application SDK to be installed directly onto the native device (Device, 2018).

In contrast, to view the web-based application on a mobile application. It requires being hosted on a server. This will be carried out using the static web hosting website called getforge.io. This hosting website is being used because it meets all of the requirements of the prototype. It is also cost-effective as it provides users with a free licence to upload files. But there is a limit to what can be carried out using this free service.

Interviews

In order to get a better insight on how flight booking systems are used in real practice. Interviews were arranged with local travel agent companies that made use of web-based and native booking systems. This enabled the opportunity to understand the popularity of mobile applications and a chance to showcase the prototype flight booking applications to the business in order to gain feedback from them. This feedback can then be used to enhance the applications in the future.

Barrhead Travel

Barrhead travel is an example of a travel agent company that makes use of both online flight bookings and in-store bookings for customers. These bookings are made by separate systems. During the visit to the company, the researcher spoke with the supervisor of the store called Elaine. She was very helpful with answering questions regarding the company and giving feedback on the prototype applications. Elaine showed the researcher, the web-based system that they use to make external bookings. However, due to privacy reasons, the researcher was not able to see the booking system they use in store but was given information about how it works.

The company application consists of the same features found on their web-based application, it gathered the same information such as destination, key dates and number of people. But it was much simpler to use according to Elaine as it required fewer options to select, compared to their web-based application and the information can be specialised for a particular customer. For example, customers may want to book additional services with the company such as hotel accommodation, food service, car service and more.

The interview began by explaining the research project and the purpose of the prototypes. Elaine seemed very interested in the project and outlined her opinions on the typical travel applications found nowadays. Elaine suggested that travel applications nowadays are very complex and require users to process too much information before finding out basic times/dates available for flights.

To give Elaine a better understanding of what was being described in the creation of the prototype applications, she was given a demonstration of them.

Afterwards, a series of questions were asked to get a better understanding of how customers feel about booking online or in-store, user security concerns when booking online and more. This information was then recorded. Elaine also provided excellent feedback on the applications which is described in the analysis section of the document.

Kohli Travel

Kohli travel is an example of a travel agent that operates using a telephone and database system to make flight bookings for customers. During my visit to the company, the researcher spoke to Aman who is the owner of the company. The researcher explained his research which was understanding the usability impacts on users during the booking process of flights. He seemed very impressed with the project and wanted to learn more. He was very helpful with answering questions regarding the company and feedback on the researcher's prototypes. Aman showed the methods they use to make a flight booking which is using a database system called Travel port. This is an API that allows the company to search through flights that are available from multiple airlines (Marketing.cloud.travelport.com, 2018). The researcher was able to see the software running and it was not very user-friendly, it involved the user to remember various initials to identify airlines and different location codes which made it difficult to use. However, Aman did say that the software does provide reliable results which is the main purpose for using it.

The researcher explained the purpose of the prototypes to Aman and he was given a demonstration on how it works. Aman really liked the design of the applications and said that it matched the criteria of an excellent application.

Aman currently does not implement a website that offers users to check the availability of flights and costs but he said that he is planning on implementing a similar approach to the applications that the researcher has developed.

Prototype Usability Testing

In order to investigate the differences between the native and web-based applications, it was given to users to test. This process was carried out by gathering a group of users, explaining the purpose of the applications and having them test each application independently. During the testing of the applications, the users will not be told which application is the native prototype or web-based prototype to keep the results fair. After the testing was completed the users will be asked about their experience of booking flights using the two prototypes and their opinion on which application is better, worse or if the applications are the same. This information will then be recorded. The applications were then revealed to the users and they will be asked to fill out a Google survey to get more information on their user experience of the applications.

Analysis of Research

Application Testing Results

This is the most important part of any project to show that the application is fit for purpose. In an attempt to avoid a mass number of errors occurring in the project. It was tested during each stage of the development process. For example, in the web-based application, before I started the next web page, it was tested to ensure that it was displaying the correct output. This process was tested using the chrome developer options found when the user's presses control, shift, j, on windows keyboards. This provides users with the ability to view the web-based application on different devices to ensure that the application is platform independent. It also helps with checking the content was displayed correctly, the console was also examined to ensure no errors were found.

Feature Testing with students

Application Features were then tested by students to ensure that applications were ready for the final tests of evaluating them for usability. During the testing stage, some errors were found. For example, when the web-based application was hosted on the web hosting website, getforge. There was a problem with the placeholder-attributes within the HTML 5 web form- not appearing in the departure and return dates of the application. This issue did not occur when testing the application, on the local browser. This was a result of the device that the application was being tested on, interpreted the code differently from the browser developer tools. This was beneficial to learn to prevent an error occurring during the final testing stage. The problem was then later solved using CSS to display the message of departure and return date into the input fields.

Another problem that was found by a user was attempting to edit a booking and information would not appear in the correct position. This was a mistake made by referencing the wrong page and the information was not found on the following screen. This was a simple fix but could have been a huge problem if not noticed during the feature testing.

A user wanted to know how the booking was successful after the confirm button was selected. Although the prompt used in the applications asked the user to confirm their booking. There was no clear signal to the user that the booking was completed. As a result, an alert message was added to the confirm button to let the user know that the booking was successful.

Interview Results

Various interviews were carried out with companies that make use of the technology for a flight booking to discover their opinions on my applications and if they are able to perform the job of booking flights. The interviews were successful and provided valuable information that can be used to provide improvements to the prototypes.

Elaine Barrhead Travel

Elaine thought the prototype applications were excellent and provided a fair representation of what features would typically be provided in a flight booking application. She thought the use of clearly labelled options and appropriately spaced buttons made it easy for users to complete a quick booking. Elaine also suggested other options that could be included such as a payment option, seating arrangements and return/ one-way options.

In respect to the differences between the two prototype applications. Elaine suggested that users in general prefer to carry out bookings on the web-based application rather than a native based application because booking flights for users is not usually a reoccurring task and users prefer to just use the web-based application. When observing the prototype application, she pointed out that the web-based application was just more responsive with respect to moving down each option. Compared to the native application that requires more effort to enter in information, in particular, the location section of the application. Elaine also pointed out that it would be better to include a feature that would allow the location to dynamically appear as the user keys in the information. This feature could be implemented in the flight booking application with the use of Geolocation API (W3schools.com, 2018) in HTML5 and in the Android application using fused location provider (Developer.android.com, 2018).

Aman Kohli Travel

Aman had nothing but positive things to say about the prototypes. He thought that the structure of the applications was good and that there were easy to navigate from screen to screen.

In respect to the differences between the applications, Aman said there were similar in performing their tasks which were providing users with the ability to book flights. However, Aman thought that the native application would appeal more to users compared to the web-based one. As users tend to trust applications that are from the marketplace such as Apple application store or the Google Play store compared to a website. He also suggested that it was important to include a padlock symbol on the web-based application to indicate to users that the application is safe to use. As a result of customers first looking at the symbol before entering confidential details. Another feature that Aman said would be useful was creating a login system for applications to differentiate between users and provide sufficient security of information.

Prototype Usability Testing Results

In order for the application to be evaluated for usability, it was given to users to test. This process was carried through different types of users testing the applications. It was carried out in this manner to gain a variety of different responses because a computing student may interpret information differently from someone that has not got a computing background. As a result, some computing students, friends, and general public users tested the applications. There were ten users in total that tested the applications. This is a small sample size test but using a qualitative approach allows for a more in-depth analysis to be carried out on the applications using fewer people.

The testing process was successful and overall users seemed impressed with the applications. It was important to carry out the testing process face to face as it allowed observations to be gathered about how users interacted with the applications. It also allowed users to give a live response about the applications as they were carrying out the booking process. Both the users live responses and survey feedback was recorded. The Google survey enabled the information to be displayed in a table format making it easier to see users feedback as shown throughout appendix seven.

Users thought the applications were excellent. They were interested in the fact that the simple design makes it easy to carry out the booking process. During discussions with testers, it was clear that appearance is a big factor when deciding whether to use a booking system or any system generally. User experience is equally important to the functionality of an application.

In figure 7.0 of the usability survey, 60% of participants preferred using the web-based application compared to the native application which came as a shock. As the native application is specifically designed for the targeted mobile device, so I would have thought more users would have preferred the native application.

When asked why they preferred a particular application, users thought the web-based application was more responsive and better in terms of layout. However, users did prefer the native application, as it was more secure and had better overall performance as shown in figure 7.1.

In figure 7.2 of the usability survey, 70% of participants had noticed the differences between inputting data within the booking page of the applications. This is true, there were differences as a result of the native application being design specifically for the smart device compared to the web-based application which is made for any device. This allowed the native application to take advantage of the full screen of the device and provide different methods of gathering data. Despite this, users did not notice a difference in the output of information within the confirmation page of the application, as shown in figure 7.4.

In Figure 7.5, users found differences between speeds of the web-based against the native application. 50% of users thought that there was a difference in speeds showing in both applications whereas 50% of users thought there was no difference in speeds. Furthermore, in figure 7.6, three out of five responses show that the web-based outperforms the native application in terms of speed.

In Figure 7.7 shows that 70% of participants noticed a difference in the video playback between the native and web-based applications. Furthermore, in figure 7.8, five out of seven users explained that the video playback feature on the web-based application was better, as it provided better video controls such as full-screen mode.

Conclusion

Therefore, this dissertation has investigated the differences between a native and web-based applications in regards to providing an increased user experience for booking flights on a mobile device. The document as a whole has carried out background research into what makes a native and web-based application and how they function. Two strong prototypes have been designed, developed and tested using a variety of different methods to add to the findings. It was discovered from surveys, testing and interviews that both the web and native-based applications are very capable of carrying out the purpose of booking travel flights. However, the focus of this document has been to exam the usability of the applications.

During the testing stages of the applications, users found that the web-based application and the native-based application booking system did have a difference in terms of its operational approach to get users information. For example, users found the web-based application more responsive in terms of selecting different input options to get the clients data and the playback of video content. However, users did find the appealing factors of the native application, as it took advantage of the entire screen of the mobile device, it was faster at navigating between screens and the start-up launch of the application as shown in the usability testing results. Also shown throughout appendix seven.

It was important to gather these opinions from users as it is the main purpose of designing the prototypes. This has been carried out through various surveys and interviews that provided a better insight into the thoughts and feelings towards the applications.

In terms of the usability, it is clear that the web-based flight booking application is better than the native-based application. This has been evident through the number of users who preferred it compared to the native application in the usability survey shown in appendix seven. However, this is not to say that native application is bad in terms of appearance, as some users preferred it and explained this point in the survey. But the majority of users do feel that web-based is better.

Recommendations for Future Improvements

In terms of the design of the prototype applications, not much is required to be changed. It provides users with a simple and easy to use flight booking system. The functionality of the application was great at showcasing a flight booking through providing the user methods of adding multiple bookings, editing booking details and saving users data. But there are other features that can be implemented in the application. These features have been suggested through various discussions with the public and the number of survey responses given regarding the prototypes.

These features are providing payment systems such as PayPal. This will not only allow users to purchase the tickets within the application, it will also save the user time and hassle. One user suggested including a reviews system, where users can write comments about destinations which will help motivate people to travel to more exotic places. Aman from Kohli travel suggested a good feature to include would be allowing users to sign in to the applications to customise the booking for themselves and prevent any anonymous users from accessing sensitive information. Another user suggested a feature that would allow the information to be sent out to the user via an email to act as an additional backup copy. This feature appears very useful in the applications, but since these are prototypes applications it will be implemented in a future update.

Although these are efficient features that can be included in the flight booking applications. It does not take away the amount of time and effort that was spent creating the prototypes. The web-based and native prototype do perform the task that they are intended for in the research document successfully.

Critical Appraisal

Overall, I found the project very interesting, as it gave me the opportunity to showcase all the skills and knowledge that I have gained in my four years at university. It took a large amount of effort to stay on track of the project due to other commitments outside of the university. But the regular meetings with my supervisor helped to keep me focused on what task needed to achieved and what stage I should be at during my progress through the research and the development of this project. Also, the Gantt chart that was created during the start of the project helped to highlight my progress and made sure that I was able to complete the project on time.

I would have hoped to get more time to further enhance the functionality of the flight booking applications by adding the features that users suggested as a future update. Although the prototype was more than capable of showing the features found on a typical flight booking application.

It was difficult for me to find academic references rather than just websites. This has been a struggle for me in other modules as well that involved background research. However, my experience in other modules has helped me to improve my ability to find references for this project.

I am very happy with the primary research section of the document. As a result of the amazing feedback that I have been given on my application and the amount of time taken to design, develop and test my applications. The development did have a few complications, but I managed to solve the issues by breaking down the problem into smaller steps. This allowed the development of two strong prototype flight booking applications.

Reference List

App, D. (2018). *Debug Your App* | *Android Studio*. [online] Developer.android.com. Available at: https://developer.android.com/studio/debug/index.html [Accessed 11 Mar. 2018].

App, e. and plc, e. (2017). *easyJet: Travel App on the App Store*. [online] App Store. Available at: https://itunes.apple.com/gb/app/easyjet-travel-app/id483568103?mt=8 [Accessed: 07 Nov. 2017].

Android Studio [Online] Available URL: https://developer.android.com/studio/index.html [Accessed: 07 Nov. 2017]

Bin Aftab, M., Karim, W. and Wajahat Karim. (2014). Learning Android Intents. Packt Publishing.

Developer.android.com. (2018). Data and File Storage Overview | Android Developers. [online] Available at: https://developer.android.com/guide/topics/data/data-storage.html#pref [Accessed 11 Mar. 2018].

Developer.android.com. (2018). *Receiving Location Updates* | *Android Developers*. [online] Available at: https://developer.android.com/training/location/receive-location-updates.html [Accessed 11 Mar. 2018].

Developer.chrome.com. (2018). *Chrome DevTools Overview - Google Chrome*. [online] Available at: https://developer.chrome.com/devtools [Accessed 11 Mar. 2018].

Device, R. (2018). Run Apps on a Hardware Device | Android Studio. [online] Developer.android.com. Available at: https://developer.android.com/studio/run/device.html [Accessed 11 Mar. 2018].

EasyJet [Online] Available at: https://www.easyjet.com/en [Accessed: 07 Nov. 2017]

Editor, B. (2018). Build a UI with Layout Editor | Android Studio. [online] Developer.android.com. Available at: https://developer.android.com/studio/write/layout-editor.html#intro [Accessed 11 Mar. 2018].

Emarketer.com. (2017). *By 2016, Most Digital Travel Bookers Will Use Mobile Devices - eMarketer*. [online] Available at: https://www.emarketer.com/Article/By-2016-Most-Digital-Travel-Bookers-Will-Use-Mobile-Devices/1013248 [Accessed 21 Nov. 2017].

Forge. (2018). Forge - Static hosting made simple. [online] Available at: https://getforge.com/ [Accessed 11 Mar. 2018].

Freeman, A. (2012). Pro jQuery. Berkeley, CA: Apress.

Hughes, C. 2006. Quantitative and qualitative approaches [Online] Available URL: http://www2.warwick.ac.uk/fac/soc/sociology/staff/academicstaff/chughes/hughesc_index/tea chingresearchprocess/quantitativequalitative/quantitativequalitative/ [Accessed: 07 Nov. 2017]

Jetbrains.com. (2018). Intelligent Coding Assistance - Features | WebStorm. [online] Available at: https://www.jetbrains.com/webstorm/features/coding-assistance.html [Accessed 11 Mar. 2018].

jQuery Mobile 1.4 Browser Support [Online] Available at: https://jquerymobile.com/browser-support/1.4/ [Accessed: 07 Nov. 2017]

KAYAK Flights, H. and Corp, K. (2017). *KAYAK Flights, Hotels & Cars. on the App Store*. [online] App Store. Available at: https://itunes.apple.com/gb/app/kayak-flights-hotels-cars/id305204535?mt=8 [Accessed 7 Nov. 2017].

kayak [Online] Available at: https://www.kayak.co.uk/ [Accessed: 07 Nov. 2017]

Law, R. and Ngai, C. (2005). Usability of Travel Websites: A Case Study of the Perceptions of Hong Kong Travelers. Journal of Hospitality & Leisure Marketing, 13(2), pp.19-31

Lubbers, P., Salim, F. and Albers, B. (2011). Pro HTML5 Programming. 2nd ed. Apress.

Marketing.cloud.travelport.com. (2018). *Travelport | The power of the platform*. [online] Available at: https://marketing.cloud.travelport.com/platform#travel-choice [Accessed 11 Mar. 2018].

Ranallo, J. (2012) HTML5 Microdata and Schema.org [Online] Available at: http://journal.code4lib.org/articles/6400?utm_source=feedburner&utm_medium=feed &utm_c ampaign=Feed%3A+c4lj+(The+Code4Lib+Journal) [Accessed: 20 Nov. 2017]

Sin, D., Lawson, E. and Kannoorpatti, K. (2012). Mobile Web Apps - The Non-programmer's Alternative to Native Applications. *2012 5th International Conference on Human System Interactions*.

The Balance. (2018). *8 Different Types of Web Hosting Services for Your Online Business*. [online] Available at: https://www.thebalance.com/types-of-web-hosting-services-2532072 [Accessed 11 Mar. 2018].

W3schools.com. (2018). HTML5 Geolocation. [online] Available at: https://www.w3schools.com/html/html5_geolocation.asp [Accessed 11 Mar. 2018].

Webstorm [Online] Available at: https://www.jetbrains.com/webstorm/

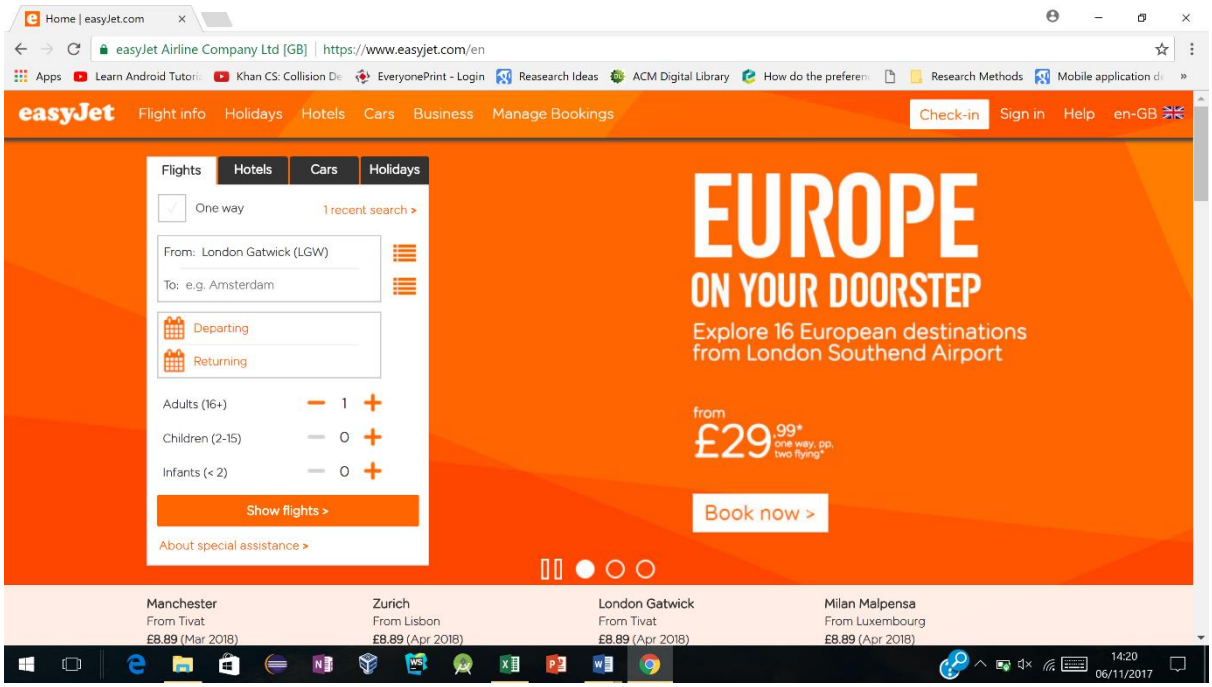
[Accessed: 07 Nov. 2017]

Weyl, E. (2013). Mobile HTML5. O'Reilly Media.

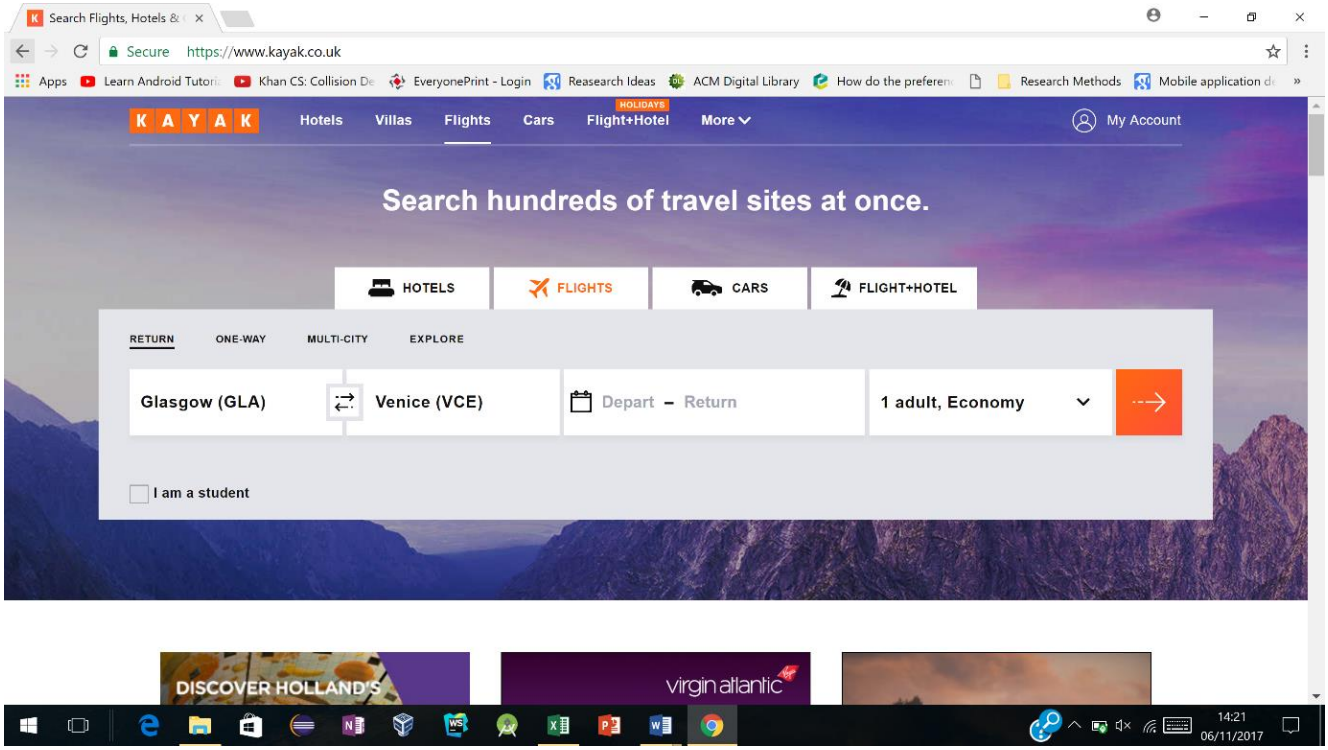
Xanthopoulos, S. and Xinogalos, S. (2013). A comparative analysis of cross-platform development approaches for mobile applications. *Proceedings of the 6th Balkan Conference in Informatics on - BCI '13*.

Appendices

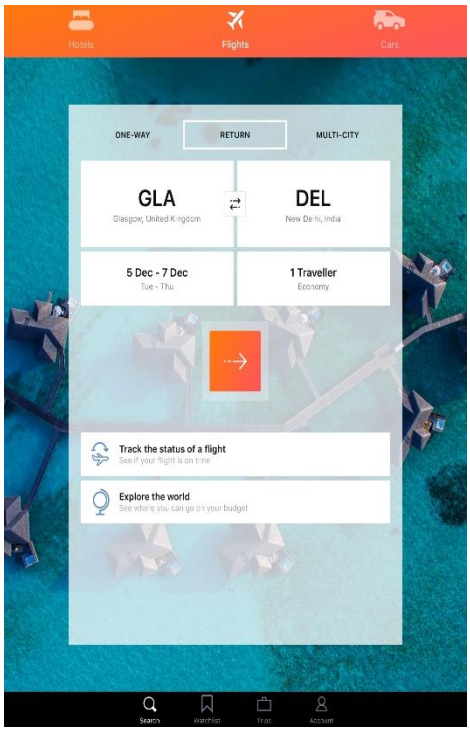
Appendix 1 - easyJet Web Application

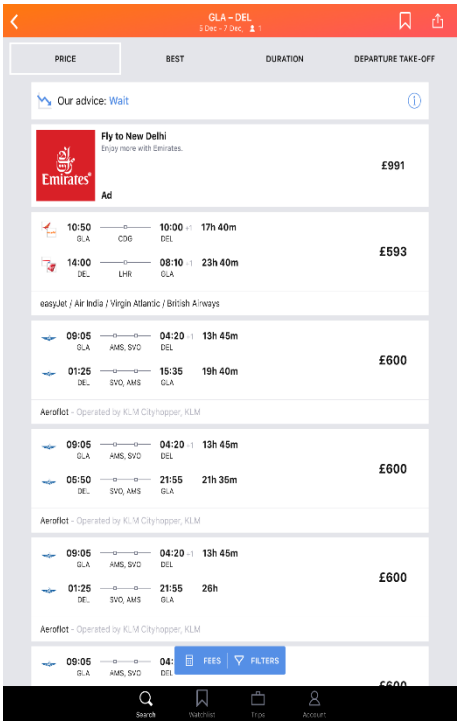


Appendix 2 - Kayak Web Application

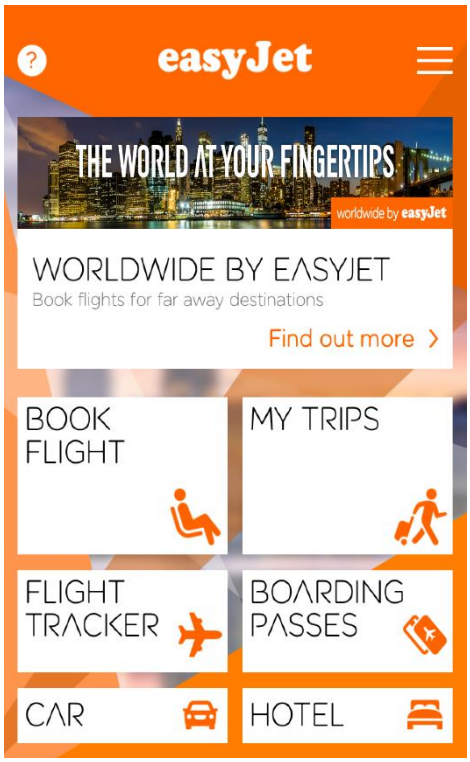


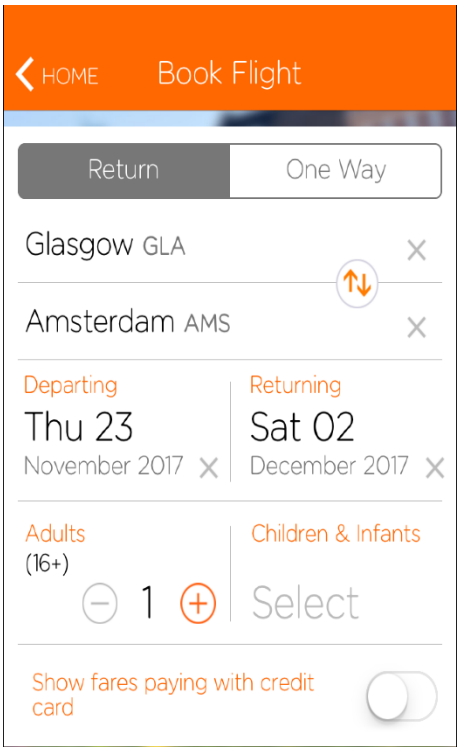
Appendix 3 - Kayak Native Application

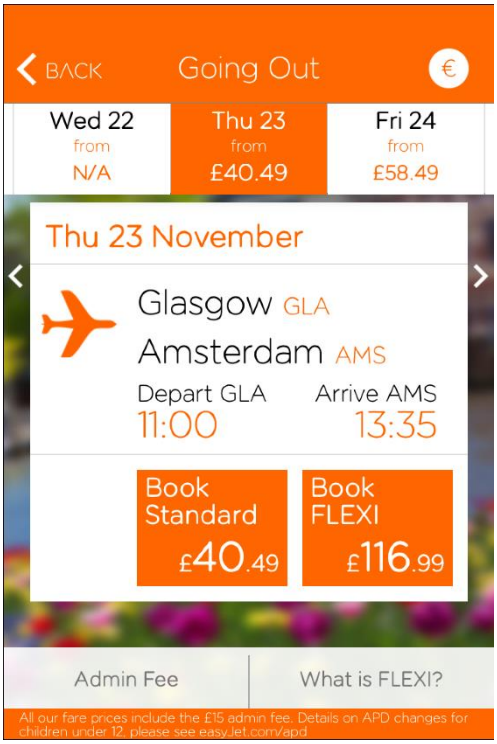




Appendix 4- easyJet Native Application







Appendix 5- Google Forum Initial Survey Results

Figure 5.0

Would you prefer to book your travel tickets at a travel agent or on your mobile device?

42 responses

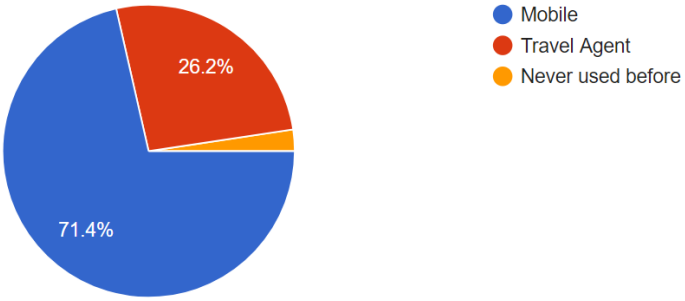


Figure 5.1

Do you feel more at ease through pictures and videos showcasing the booking process of the application?

42 responses

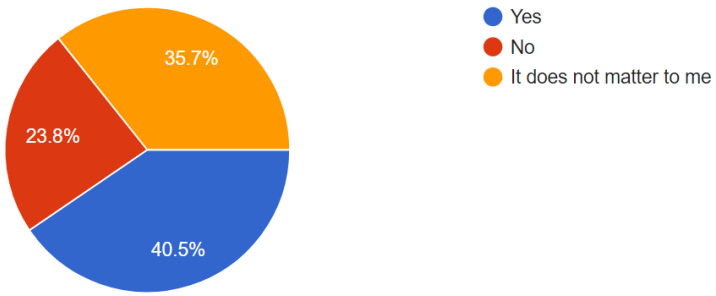


Figure 5.2

When booking your travel tickets on your mobile device does the appearance of the application change your mind on the purchase?

42 responses

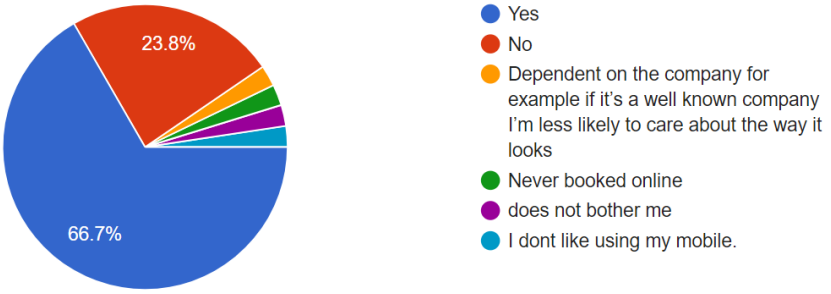


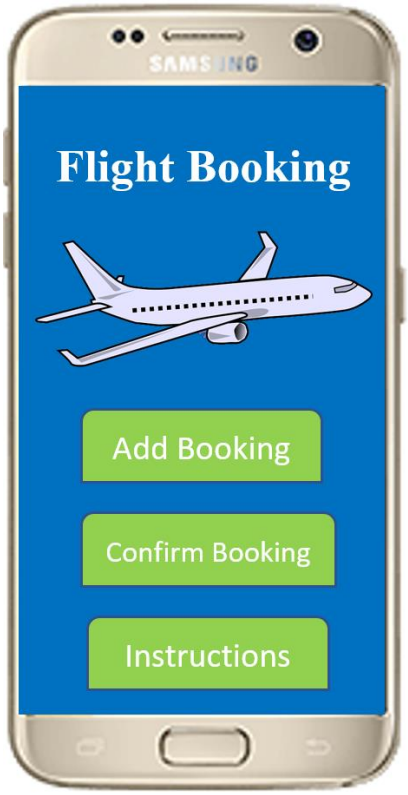
Figure 5.3

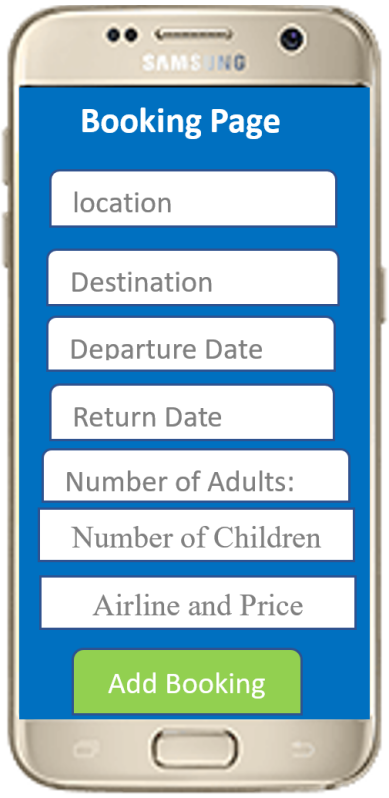
What features do you look out for in a travel booking application (for example graphical calendar to enter key dates, choice of different airlines to travel)?

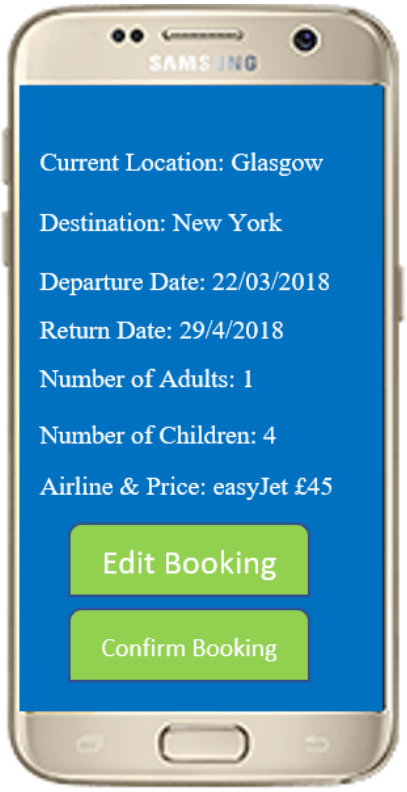
36 responses

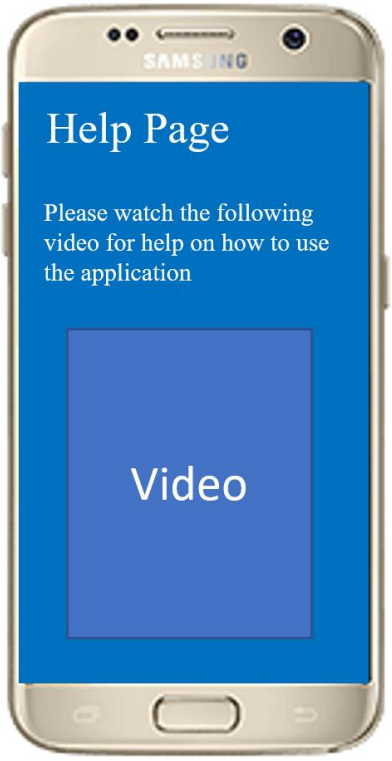
Plenty of choices in airlines to travel and dates etc
Choice of different airlines, showing the prices of close dates to compare (easy jet has this)
Key dates +/- a few days, comparisons with how much you were saving using that site
Callander, showing cheaper prices for alternative dates, different airlines which may be a better price
graphic calendar that shows the dates they fly
Calendars, list of destinations and sorting tools
graphical calendar to view dates keeping it simple not to complex
graphical calendar to record info
easy to use, simple and quick
keep it simple and ensure that usability is well implemented
choice of different travel airlines to compare money. I like a good deal
easy to use

Appendix 6- Prototype Design









Appendix 7 Usability Testing Results From Survey

Figure 7.0

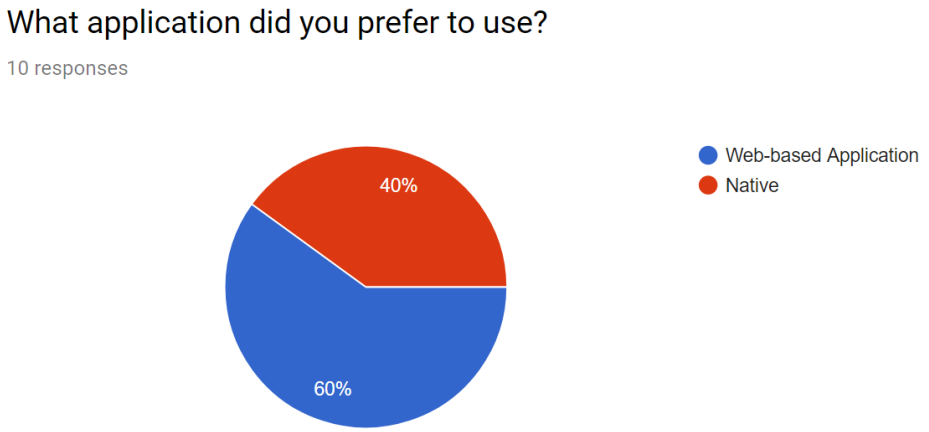


Figure 7.1

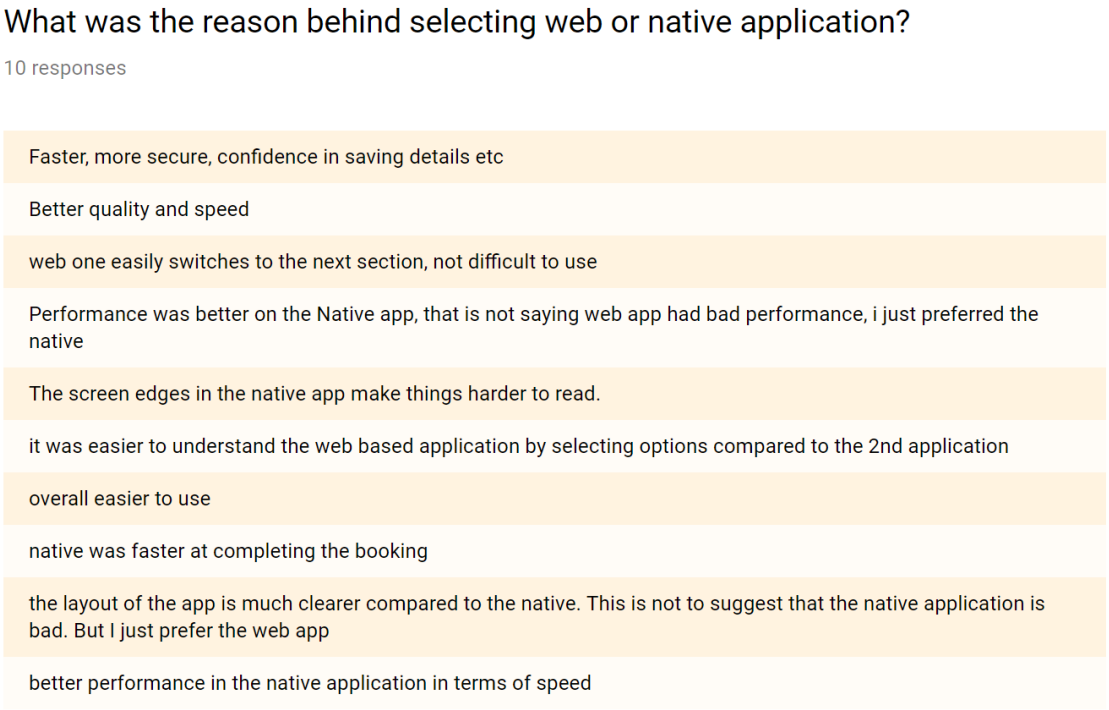


Figure 7.2

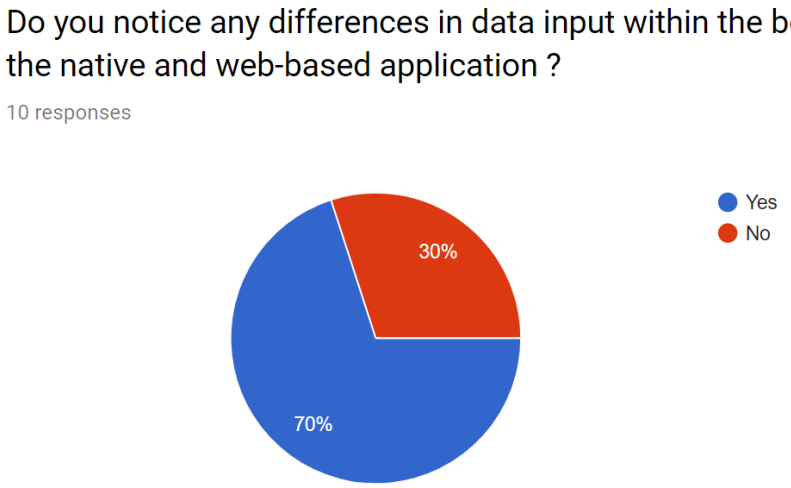


Figure 7.3

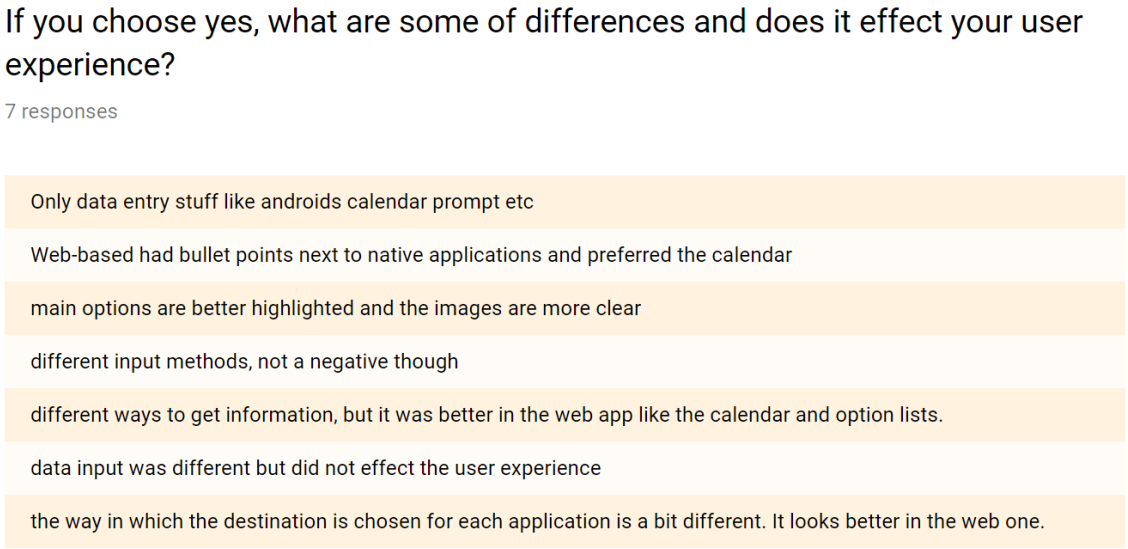


Figure 7.4

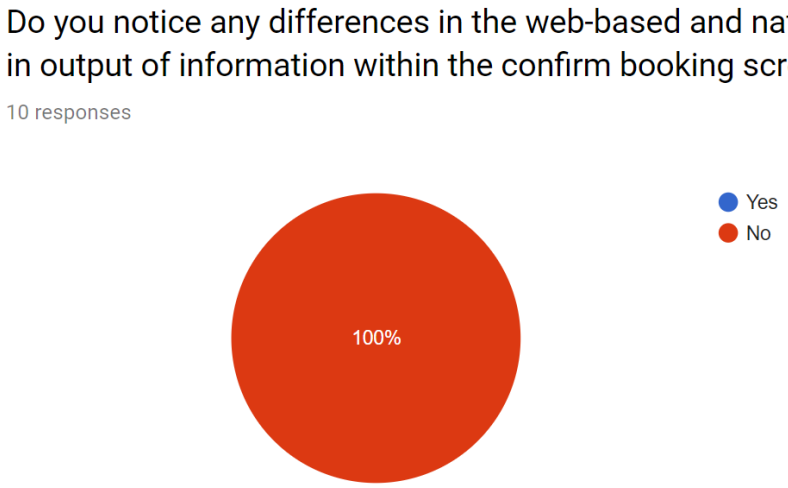


Figure 7.5

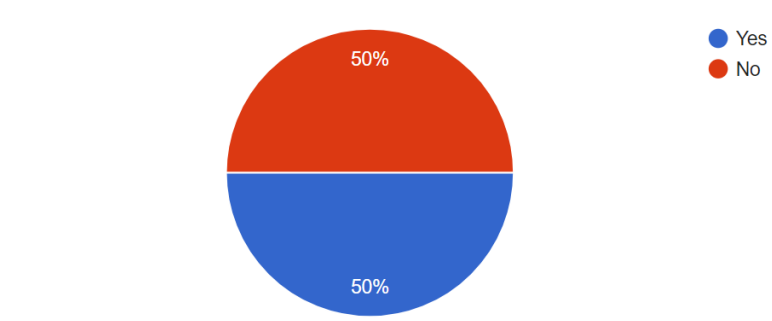


Figure 7.6

If you choose yes, which application is faster and why?

5 responses

Web-Based
web is faster and easier to uer
web is easier to move from screen to screen
native was faster. I guess because it is made for your phone
native was faster

Figure 7.7

Do you notice a difference in video playback between the native and web-based applications?

10 responses

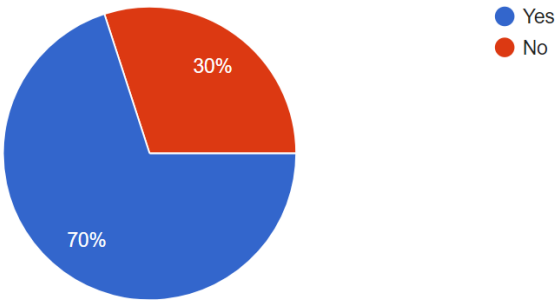


Figure 7.8

If you choose yes, which application is better at video playback and why?

7 responses

Native was louder and more clear
Web-based had better options like dragging across to certain time
web is better with video as tool bar is better seen and more options available
Web had better controls for the video than the native app
I think the native one autoplayed?
web has better features such as full screen mode
better video controls in web application