

Project Report: Research on Usability Study of Responsive and Adaptive Websites

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Research on Usability Study of Responsive and Adaptive Websites

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CHAPTER 1 - INTRODUCTION

Introduction

Due to rapid development internet and internet enabled technologies web sites are becoming popular. Previously people uses internet for various purposes only into their desktop pc. However, the last few years, the mobile technology has a changed remarkably and technologies make huge changes on the display screen especially in mobile screen. The mobile previously used only for making call or receiving call but now it can do all the internet activities as like as desktop or laptop device as a result number of mobile users and mobile devices has grown significantly. Since experiencing accessing website in desktop is habituated by all so it becomes a great challenge for the designers to give the same experience while accessing the site in mobile. Thus it becomes an important issue to providing a, high-quality and seamless user experience on different display device.

Lynne and Lasen (2006, cited on "The Mobile World: Past, Present and Future" - Page 96 [1]) the internet becomes accessible in mobile phones in the late 1990s limited to display only basic textual data. In the mid-2000s when smartphones were started coming the real experience of website started to achieved. The main reason of that the smartphone allowed to display websites the exactly same way as desktop computer is with having some problems including that the navigation was not too friendly. That means there was limited navigational system in the site obtained from mobile devices. After that mobile phone manufacturer introduced technology called the Wireless Application Protocol (WAP).



Figure 1: Preview of an adaptive site when viewing on a smaller screen [2]

Kathleen and Smith (2014, [3]) described there are some limitation are still with mobile websites and all those problem would be removes. The main problem was still there, because browsers in the mobile phone have limited capability to response with CSS and JavaScript and other standards compatibility. To resolve that problem the developers started to develop website site for mobile and that uses only with the basic HTML, CSS and JavaScript. As a result the organization has to maintaining two sets of sites whereas the site for desktop has the full functionality and the site for mobile containing the limited functionality. But it was seen that the consumer experience on mobile website become worst day by day. Thus it becomes the headache for the designers and the stakeholders also.

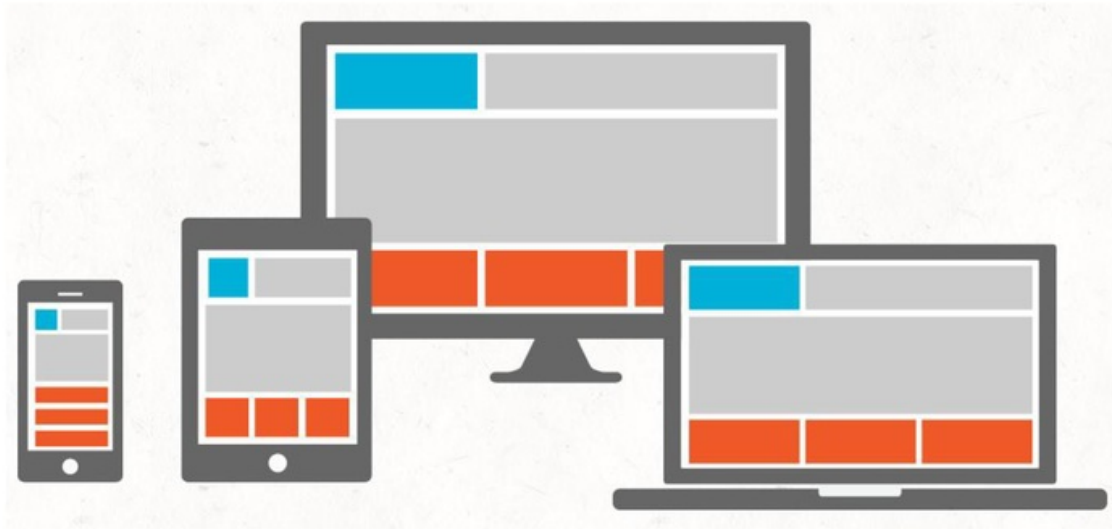


Figure 2: Different screen size available today [4]

Then comes Responsive Design concept, it is a scenario where the concept of a design will give the user the same look and feel whatever the screen size or the device. An article published online by Ethan (2014, [5]) titled "Responsive Web Design" describes the end of 2012 this concept comes into effect with the name as Responsive Web Design (RWD) however; It is perhaps one of the best ways to handle the issues that arise to display the website for different screen on different devices. Now the same HTML, CSS, and JavaScript used for website are able to provide the same feel with different screen sizes and resolutions. The key technology used in this process that website process in a device based on device's Media Queries.

1.1 Aim:

The aim of the project is

“Research on Usability Study of Responsive and Adaptive Websites”

1.2 Objectives:

Project objectives are given bellow

- Design and Develop a Responsive and an Adaptive Website
- Conduct surveys for developed Responsive and Adaptive websites
- Produce Result from the outcome of survey
- Discuss limitative of current project
- Recommend further improvement

1.3 Reports Layout

Chapter 1 Introduction:

This chapter includes introduce topic responsive and adaptive website, project aim and project objectives.

CHAPTER 2 - RESEARCH & REVIEW OF LITERATURE:

This chapter includes details description about responsive and adaptive web design methods and review of scholars about the topic.

CHAPTER 3 - RESEARCH AND/OR DEVELOPMENT METHODOLOGY:

this chapter includes the research methodologies f or software development their features, advantages and disadvantages and also justification of the research methodology chosen for the proposed project.

CHAPTER 4 - DESIGN & IMPLEMENTATION:

Design and implementation chapter includes the details about the system design and development, methods and tools used for the development.

CHAPTER 4 – ANALYSIS:

This chapter describes details about the data collection process and result calculation.

CHAPTER 5 – EVALUATION:

Details description of responsive and adaptive website evaluation and research result evaluation based on data analysis.

CHAPTER 6 - CONCLUSIONS AND RECOMMENDATIONS:

Conclusion and recommendation includes details outcome of the project, limitation and recommended further improvements.

CHAPTER 7 – REFLECTION:

Reflection chapter contain the learning outcome form the project work.

CHAPTER 8 – REFERENCES:

includes references and bibliography

CHAPTER 9 – Appendix:

Websites pictures and other data collection forms and usability testing that applied into this project.

Chapter 2: Research and Literature Review

2.1 Mobile website

Matthew Sacks (2012, cited on his book Pro Website Development and Operations: Streamlining Page 33 [6]) the term is very well-known by the mobile users as well as the website developers. This is because the mobile cannot provide the same feel as desktop. The website in the mobile can only have the text data however, the introduction of responsive design make the web experience almost obsolete. While designing a website the designer and developer should emphasise on the content of the site whether it is for desktop or mobile versions. It is because the responsive design maintains the core content to make available to any device. For responsive design only developer only need to design a single backend structure for the website. It's important to them to show the different content depending on the context depending on the display screen. So for the mobile website the designer carefully consider about the content strategy to show. If the content cannot be consumed in different context the website will not be succeed.



Figure 3: Accessing the website using various devices in the period 01.2011. To 01.2014 based on online article Responsive web design – Are we ready for the new age? [7]

2.2 Responsive website

According to Hinderman (2015, [8]) "The responsive website is an approach to design a website which will provide an optimal viewing and interaction experience". It is expected that the proposed website would provide the same look and feel on every device i.e. easy reading and good navigation. Here the user would be accessing the website with minimum scrolling and resizing website across the devices. These types of sites created the layout using fluid, grids, flexible images and last version of CSS3 media queries. The tasks of fluid grid reorganize the page element in relative percentage units rather than pixels. The flexible images are used in responsive website also resized in relative units so that they cannot break alignments. Moreover, media queries helps webpage to use different CSS style depends on screen size. Thus it becoming more attractive as the amount of mobile responsive site traffic has come to about half of total internet traffic. The following screen print shows how responsive web site react with different screen sizes for example on mobile, tablet and desktop [8].



Figure 4: Preview of fluid responsive site in Mobile [4]



Figure 5: Preview of fluid responsive site in Tablet [4]



Figure 6: Preview of fluid responsive site in desktop [4]

2.3 History of responsive website

Last few years there were not such varieties of screen size were available and almost all the monitors or screen were 800 x 1024 pixels and that time the websites were fitted well on most of the desktop or laptops screens. However when there are invent of various screens size so it become thinking issues for web designer's to look and feel website exactly same no matter of users devices. Responsive website is the modern solution that resolved fixed-width issued from past web design method.

In May 2014 in an article was published by a web designer Ethan explained about the fluid grid i.e. how the design landscape design was significantly changed due rapid increase of exponential mobile users. He also described on his book "Responsive Web Design" the theory and practice of responsive web design [4]. This article explored the new era of web design and then comes the concept of "Responsive Web Design". In fact, this article changes the traditional concept of website in the mobile devices.

An online article published on 2014 titled "Responsive web design" mentioned that In late 2001 the first website was launched with the responsive layout for giant car manufacturer Audi created by a team web development consists of Ken Olling and Jan Hoffmann. This website was successfully resized the in Internet Explorer but the other browsers such as Netscape the pages had to be reloaded from server based on device size. By the end of 2008 there comes the concept of liquid, flexible that is used in designing the website layout. At the same time the browsers were also capable to incorporate the CSS3 media queries [9].

According to Mashable (2015, [10]) the year 2013 is called the "Year of Responsive Web Design". There are different sources that are agreed that this technology is an alternative way of developing mobile application. It has showed that this technology is cost-effective and easy to maintain.

These days all the website releasing based on responsive technology and all the old websites are moving to responsive design. The World Wide Web Consortium (W3C) have developed HTML5 and CSS3 to support website on different and currently web designers can use these to make their sites interactive and functional on the web. Modern browsers are also included these new standards to support this technology.

2.4 Responsive web design technology

Sue (2012, [11]) has mentioned (on her book Web Design All-in-One for Dummies - Page 354) the responsive web design are based on main three concepts i.e. media queries, flexible widths, and flexible images. There is another concept i.e. fluid grid is a concept of layout technology that is used for resize the layout columns and widths of content changed as per the percentage of the browser window. Thus the website pages can be viewed regardless of the device screen so for that website requires some mechanism to display contents without losing consistency and style.

The designer or developer uses the media queries to change the CSS depending on screen size. The screen and device display capacity also varies including how device processing web request and content support for example some browsers are limited to process JavaScripts content or some browsers compile them using different mechanism. Thus the fluid grid and media queries help web designers to develop a websites that truly respond to its context without sacrificing the user experience. This is necessary to keep in mind that the content of the website should be easy for consumption for the end user or consumer.

Almost every single type of devices and platform are launching in the market and website browsers need to works all devices. According to Veen (2014, [12]) "Responsive website design represents fundamental shift and this is how we will build website for the next decades".

transform	 10	 16	 -webkit-	 -webkit- 3.1
transform-origin	 10	 16	 -webkit-	 -webkit- 3.1
transform-style		 16	 -webkit- 12	 -webkit- 5
transition	 10	 16	 26	 -webkit- 3
transition-property	 10	 16	 26	 -webkit-
transition-duration	 10	 16	 26	 -webkit- 3
transition-timing-function	 10	 16	 26	 -webkit-
transition-delay	 10	 16	 26	 -webkit- 3

Figure 7: Browser support for CSS3 properties [4]

2.5 What is Usability

The word usability refers "how easy a product or a system to use and maintenance" defined by Veen (2014, [12]). This is the quality of the product that how much it user friendly. How easy to access it's interface. Usability not only refers how easy the final product to use rather it also refer how much it includes the process for improving ease of use during its design process.

Usability means user-centered design. Usability refers that the design and development process to make the system should focus around its prospective user so that it becomes able to meet their goals and requirements [12]. The international standard, ISO 9241-11, provides guidance on usability and defines it as - "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". In general the word usability consists of two related concept first of all the it is the quality of the product or system and the second one is tools and techniques are involved to design and development.

Based on an online line article published on 2015 [13] titled "Mobile marketing statistics 2016 - Smart Insights" by Dave Chaffey describes that last few years due to rapid growth of mobile devices specially mobile phone configuration are changes to interact with complex multimedia system and that makes mobile devices are the fundamental shares to our life. This day it is possible to live broadcasting to website video are captured from different devices and different format also some television websites developed live broadcast enabled website and web application to help their channel to broadcast live for example of BBC, Sky Television etc.

Universal interfaces the importance of the mobile devices within our society increasing because of those features and functionalities. Accordingly mobile usability evaluation it is necessary to upgrade the related technology so that they can easily cope with the new invention. This technology should be usable for the end users. A highly usable system provides lots of benefits to users as well as the business by helping users to use the application easily and smoothly without any frustration. It is the important factors to consider while develop a system that how easily user can use else total aim of the project would be hinders. Moreover, it also helps business to achieve highest customer satisfaction and easy customer support to do so business can raise their profit margin.

Carefully usability inspection helps us to find out the defect of any system and help us to improve further. There are lots of usability factors to be considered while carried out usability testing for a system. The most common, widely used and effective usability inspection criteria and also relevant to this project are given bellow

2.6.1 Heuristic Evaluation

Heuristic Evaluation method is the one of the convenient and easy evaluation method of the user interface. After the several years of experience in teaching and consulting about usability engineering Nielsen and Molich (1995, [14]) highly proposed heuristic evaluation method for use interface evaluation published on their website 10 Usability Heuristics for User Interface Design. This is the most popular method because it requires less resource and expertise. Heuristic evaluation method helps us to easily identify defect related to user interface.

2.5.2 Cognitive Walkthrough

The goal is to identify a system after developed that how well its interface assists the first time or infrequent user without formal training or experience. This method is more consists of detailed procedures that help us to identify product defect in each step using dialogue and special kind of checking. Nielsen and Molich (1995, [14]) suggested cognitive walkthrough started from beginning to end of the process based on series of tasks.

To apply this method on a product expert initially developed a set of questions from the perspective of the user and identify those answers so that it can helps them to detect earlier design flaws throughout the development period to release the final one.

2.6.3 Feature Inspection

This technique is used on the basis of the features set of a product. In this technique first of all some use cases is defined with the end result and those use cases are defined based on the product feature after that evaluator apply those use cases on to the product.

This approach includes or excludes features emphasizing the necessity for the end user [17].

2.6.4 Consistency Inspection

Consistency inspection method is used for checking the internal or external consistency of user interface. Consistency inspection is applying to evaluate products consistency every single step of the product development lifecycle. For a web site evaluation it measures the consistency features of within the screen and on the screen as well as colour, layout, text, icon and style.

2.6.5 Pluralistic Walkthrough

McGrane (2015, [19]) defined the goal of this method is to identify the issues or features in a system so that it can be able to maximum usable human computer interface. Here a group of users and usability professionals are working together. They have developed a set of tasks and based on that they discuss and evaluating the usability of a system. It is because more people are working with the same goal i.e. looking for problems in the system so there is higher probability to finding errors and resolve before the final release of the system [16]. Pluralistic usability walkthrough is a usability evaluation method that combined idea of user interface form the user and system designers.

2.7 Principles of good website usability

Over the past few years there have been developed certain standards for web design. In order to make a site attractive to the viewers with long lasting impression it needs to design and develop the site a usable one. Again the invention of technology the website can now move to display on different screen size so before going to design and develop these points should be keep in mind. Based on the screen difference the usability issue now takes a most consideration part of the usability inspection issue. This mean usability has become more important issue and hence it just takes on a different role in web design for a great user experience. There are some principles for good website usability defined by Nielsen Norman Group [17] are given bellow

- i. **Availability and accessibility:** The site should be available and accessible for the user round the clock. The site should be accessible anywhere beyond the geographical area. It means the uptime should be approximate 100%. There should be no dead links [17]. It can be handle different screen sizes and different mode of connections.
- ii. **Clarity:** The site should be simple and familiar. The consistency is important here. If the user cannot get his information it might make they confuse as a result they will require more time to find what they came for, or they might forget their initial goal [16]. Either way, the user experience result the website is not user-friendly.
- iii. **Learnability:** The site should have such interfaces that don't require instructions. It should be in such type what people already know. There may create new interface but it should be easy to learn also this day people are familiar with different design

concept used in website. As human beings, they are familiar patterns recognition, which is easier to handle by used rather than unfamiliar one.

- iv. **Credibility:** It's important to have a website the credible information. It may be having "About Us" page in the site. This is because people who visit the site they want trust. If they find the origin of the site they easily trust the site [16]. Without trust the content of the site become valueless even they consider most reliable.
- v. **Relevancy:** It is necessary to having the contents of the site not only be clear but also relevant of the goal. For this reason the organization mission and vision is important. The content should be put after analysing what the user wants from this site. Without proper brain storming about the visitors the goal of the site may chance to go in vain.

2.8 Usability issues for Developers and users

This is crucial how much a system is usable to its end users. An online article published by Patel (2015, [20]) titled "Neil Patel's Eight Pet Peeves About Most Blogs" describes usability may not be happen that the user of the system are all literate and know better how to use it. At the same time it also true the opposite of the former comment. So what are the usability levels? Consider for the perspective of the programmer of the site. There are web programmer and Java programmer in the website design and development project. So there perspective of thinking should be different. A web developer always concentrated on how the look and feel of the site satisfies the user. But a Java programmer on the other hand concentrated on how the connection established with non-breakable. In both cases their perspective is right. But concentrating any one should not be fulfilling the whole project. In the same if the site containing more error handling then it might help some user but may be the cause of frustration to the other user. If the contents are detailed this may help some visitors but some visitors may feel disturbance on it because to find his actual requirement he has to spend much time on it. So it cannot be said a better usability is not helping only for the end user but also developers.

2.9 Mobile first content first

A responsive website design comes from the variety of screen resolution. This is because in a large screen it is possible to show all the information with some attractive images. But when it

comes for the mobile users then there is need to think about the users. The user who are accessing website into their mobile they won't like to see the overall information rather they concentrate on what they required. So the information displaying in the mobile screen have been limited with specific content. An online article published by James (2013, [21]) titled "Best mobile emulators and RWD testing tools. The Mobile Web Design Blog" described a good responsive web design is born for mobile-first approach. It is the process of designing backwards from the smallest-sized device. The designing a responsive website needs to make analysis what are the contents should be display especially in smaller screen. The web designer committed mistake in such way that they first design a website first for desktop screen and then crunching, rearranging, and hiding content for the smaller screen.

The designer first decided what are the information should the visitor would receive as soon as they enter into website.

The mobile user only wants information and they want it fast. Too many designers are taking content from their desktop sites and whittling it down for someone accessing it on a mobile device [21].

2.10 Advantages of responsive website

Smashing Magazine Define the following advantages and disadvantages on his article published on 2013 are given bellow [22]

- i. **Superb flexibility:** The contents of such website are freely adjustable across the screen resolution no matter whatever the device is. Here both the images and grids are fluid. Thus the front end result is always same on the device screen.
- ii. **Outstanding user experience:** When the user finds a website which provides them web experiences same on all screen i.e. not depending on the device types then they feel best experience. This experience enables then to visit the site and consume the products or services whatever it offers. Thus it reaches maximum number of users.
- iii. **Brand consistency:** In any business there is a major concern on its brand consistency. Having a responsive design, it can guarantee that the brand is presented similarly across all kinds of devices.

- iv. **Cost effective:** If the website has several version depending on the device so there have to maintain several site cost. On the other hand the user needs to maintain different link for the same site. This is very much inconvenient for them. And of course it makes the cost higher for the organization. Since the responsive website design enhance the techniques so only one link is enough to display the information on the screen. This makes the cost lower for the organization.
- v. **Manage Search Engine Optimization (SEO) campaigns:** If there are separate site for mobile and desktop then it requires separate SEO campaigns. But for a responsive website there is no such requirement. Thus it becomes easier to manage one site SEO campaign compare to managing two sites and two SEO campaigns.
- vi. **Usability:** A responsive design is extremely user friendly. It is because if a user once having experienced the site in one device and the same user will view the site in another device they do not search the same thing again; they already know how to use the website.
- vii. **Increase customer:** If the site having responsive technology then it will attract more visitors and there is great chance to make them potential customer and thus earn more revenue. It is because in such site there is no scrolling or resizing is needed for any visitor to access the website from their favourite device i.e. desktop, laptop, widescreen, mobile screen, iPad view, iPhone screen etc.
- viii. **Easy maintenance:** Since a responsive website is supported to all sorts of devices so if there is required to change, only make those changes placed in one site. Thus it is quite easy to maintenance a site compares to maintenance different link of the same site [28].
- ix. **Recommendation by Google:** Google states that there recommendation for mobile configuration is responsive web design. Since regardless of device a responsive design websites have uniform URL and similar HTML content that is much easier and efficient for Google to crawling, indexing and content organization. On the other hand if there is separate link then Google also needs to crawl and index multiple versions of the same site.
- x. **Load time:** Users viewing the responsive website need to have very good internet speed and that will help user to download seemingly large amount of data without having any problem because responsive website resized automatically based device's screen size.

2.11 Disadvantages of Responsive Website

Main disadvantages are defined by Frain (2014, on his book Responsive Web Design with HTML5 and CSS3, Second Edition, Page 128, [23]) following disadvantages of responsive websites

If the plan is to update the existing website there it requires change the entire website. It would not be work if there is slide modification of the site.

- i. A responsive website takes longer time to develop rather than the creation of a standard site. Since there is some tricky so it takes almost 20% extra time to design and develop of the site [23].
- ii. People browsing the internet for their specific needs. So sometimes this site boar it's users to figure out the specific information.
- iii. A responsive website operates using the browser's built in functionality named media queries. The media queries tell the browser what screen size it is currently being viewed on. The older version of the browsers doesn't have this facility.
- iv. Sometimes the navigational system become complex in such types of site. The problem depends on the screen resolution of the display system.
- v. Since a responsive website is somewhat uses tricky technology so there is required some extra cost to develop it. The cost is higher than to design and develop a standard website.
- vi. A responsive site is loaded first and then resizes it. Thus sometimes it is seen that the page loading times is vary on the display devices.
- vii. In a responsive site all the content are downloaded first. All the contents are may be not required for the user but it downloaded. Thus it makes the site slower [28].

2.12 Future of Responsive Website

At this moment of time it is not clear that what will be the future for responsive web design holds. It is because it is not known that what are the devices are in the pipeline to come. Also it cannot be explain how the world will react against these devices such as wearable smart-watches, glasses etc.

Castledine (2011, [23]) said previously the website contains various Flash videos and programmes. But these Flashes have become obsolete now days. Currently the web is moving

towards standard-driven web development approach. In this technology there is introducing HTML5 and CSS 3 for developing and designing websites [22].

Therefore new technologies need to adjust to the website design such as touch responsive. The website in future may be audio responsive web pages.

Another issue also mentioned by Castledine (2011, [23]) that the mobile devices and their capabilities are changing day by day. For this reason their viewport sizes are also different. The designers would face this challenge to adjust the site within these viewports and their higher resolution displays. The iPhone 4 was the first widely used device to implement a high-resolution display having 960 X 640 pixel resolution and in at 326 pixels per inch which is double the pixel per inch density of laptops such as the 2011 15" MacBook Pro. But the responsive tools had the capabilities to support enhancements the website for these devices. Suppose a website required to load a higher resolution version logo for users of high-resolution displays. Here is the markup for the logo area:

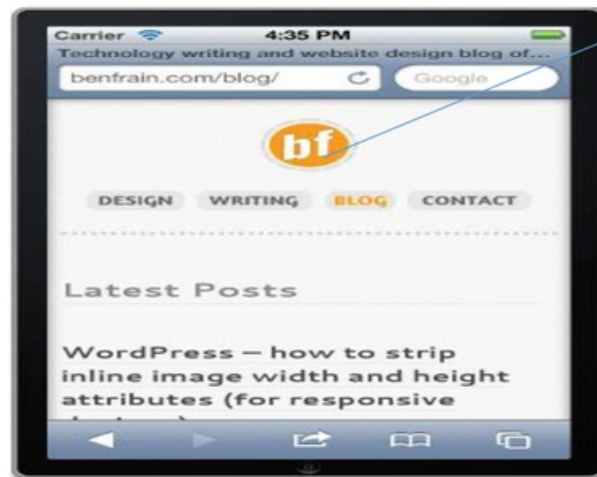
CSS Snipped

```
<div class="logo">
    <a href="http://benfrain.com/"></a>
</div>
```

And here is the CSS rule that loads the logo:

```
#container header[role="banner"] .logo a {
    background-image: url("../image/logo.png");
    background-size: contain;
    background-repeat: no-repeat;
    display: block;
    height: 7em;
    margin-top: 10px;
}
```

The logo looked like the below screen.



```
<div class="logo">
  <a
    href="http://benfrain
    .com/"></a>
</div>
```

Figure 8: The low resolution screen loading page [29]

The above image shows that the logo is perfectly setup within a screen. But it would not be the same if the resolution becomes higher. In responsive website design there is the solution which is media queries. To fit the logo in a higher resolution double the size of the existing logo and named them logo2@x2.png and logo2Over@x2.png [23]. Then added the following media query in the CSS as per below:

```
@media all and (-webkit-min-device-pixel-ratio: 1.4) {
  #container header[role="banner"] .logo a {
    background-image: url("../image/logo@x2.png");
  }
  #container header [role="banner"] .logo a:hover {
    background-image: url("../img/logo2Over@x2.png");
  }
}
```

Generally when the browser loads a page the media query functions then it target the devices with pixel ration of 1.4. Therefore high resolution displays like iPhone 4 and later the higher quality version of the logo is loaded [24]. This is shown in the below screenshot.



Figure 9: High resolution screen to load information [29]

Comparing the two images it has been found the difference is indirect. Larger images equate to larger file sizes and longer download times. A new technology has come named Scalable Vector Graphics (SVG) which is used to improve many of the image scaling issues that is currently faced.

2.13 Why responsive website is important

Responsive website is almost the safer option to go. It always functions well regardless of screen sizes with improves loading times. An online article published by Clickbruza (2015, [25]) describes fluid design technology gives user a finest experience no matter what the device is. It allows one HTML file to run on various environments. Responsive layouts started by creating focusing the viewport at mid resolution and then use media queries to adjust for low and high resolutions.

Mobile users are now growing day by day. They want to accessing mobile websites and making transaction through internet. So these websites should be optimized seamlessly for all devices. The responsive websites has been created with one URL and one set of code. So there is no required to design multiple websites and worry about multiple URLs. The same URL will provide

the website viewing regardless of PC, laptop, tablet or smartphone. And the website will automatically reorganize itself to fit the device's screen being used to view it. Thus it will save money from both a web design and administration standpoint.

Different
Screen
Sizes



Different
Screen
Densities



Different
Input
Methods



Support
for
HTML5



Figure 10: Variation of resolution [Google Images]

In 21st of April Google has announced that they would demoting all the website are not mobile friendly. It is because if the same site has two different URL then it will create complexity in SEO. So it is better than make one site which will opt any display.

2.14 Cost Quotation Software

Prior to software development there is required to software cost estimation. Due to downgrade the hardware of the computer system now the software cost becomes higher in any computer system projects. The cost estimation is done based on human effort i.e. the cost estimation methods give estimates in terms of person-months. The cost estimation is very much important to both developers and customers. This is task that is done prior to developing the proposals, contract negotiations, scheduling, monitoring and control. If this is underestimated may result in exceed the software budgets and if this should be done within the budget then the outcomes may be underdeveloped functions and poor quality. Also overestimating the cost may also result

in too many resources entitles into the project that will in threat in loss of jobs in future? Thus there is necessary for accurate cost estimation defined by Veen (2014, [26])

- i. Accurate cost estimation prioritizes development projects with respect to business plan.
- ii. It helps to determine what resources required to the project and how well these resources will be used.
- iii. It gives the stakeholders a picture about the impact of changes and support preplanning.
- iv. If there is proper cost estimation then it is easier to manage and control resources
- v. The stakeholders always expect that the estimated cost must be equal or less than estimated cost.

Saul and Helias et al (2012, [27]) defined "There are several cost estimation models and software that will calculate and generate the cost estimation and that is considered as product development cost". Although lots of cost and efforts related to each other cannot be considered as same. Effort is generally calculated time spender by programmer, testers and project manager to release a particular project.

These cost estimation software are simple enough to use for both the administrators and service providers. They can use these for measuring recurrent direct cost of the project. Saul and Helias et al (2012, [27]) described there are several reasons for focusing direct cost by this software. Such as –

- i. There are some indirect costs which can be minimizing by rational use of the resources.
- ii. The direct cost is positively related with some services which cannot be less.
- iii. The direct costs are simple to calculate
- iv. For calculating indirect cost it may not be possible to get all related information instantly.
- v. The indirect cost are varied in nature

For the above reasons it is seen that may organization are using such tools and generate more complex and comprehensive cost analysis. Good cost estimation software makes potential benefit at both levels. It ensures the accountability and efficient use of funds. The use of time is effectively used since more time required extra budget. Besides this it helps to recognition and

involvement in enhancing efficiency. The stakeholders can get a clear picture about the project rather than costing haphazardly.

2.15 Responsive website challenges

Wroblewski (2014, [28]) has explained on his book "Mobile first, page 37" that a website developed with the responsive web design method where responsive web design with server-side components is incorporated is giving the user experience better for mobile devices. In order to improve usability there is also used server-side "dynamic CSS" for creating of style sheet and accessing a server based API that handles the device screen variations in conjunction with a device capabilities database. Google has also highly recommended responsive design for mobile websites over other approaches.

The designer are facing one on going challenge in deploying responsive site is that there are some banner advertisements and videos are not fluid. It is because those advertisements are not making for different sizes of screen i.e. they are not vary for desktop, mobile, iPad etc. As a result these could be the same size in the screen which generally causes the website looking hazard. In such scenario AJAX can resolve the issue by using different advertisement variants on a page.

Jennifer Kyrnin (2014, [29]) described that there are now many ways of validating and testing RWD design. These are varying from mobile site validators and mobile emulators to simultaneous testing. The Firefox browser and the Chrome console has built in functionality that offer responsive design viewport resizing tools and that can be applicable to third parties browsers.

2.16 Difference between Responsive and Adaptive Website

The users are not care what is the method used in the website that they accessing, they only case is the site how effectively they access the website. For this reason the developers are trying to invent new technology and adopt modern logic behind the development of the site. Vincent and Ashman et al (2013, [30]) described on their book that currently the website are developed are or two types i.e. responsive and adaptive though both of these addressing the issue for rendering websites on mobile devices. Example of the Responsive website is Facebook, YouTube etc.

2.17 Responsive Website

This type of site provides the optimal viewing experience of a website by not depending on the user's device. Here the CSS3 is incorporated, use the media queries rule and use fluid grids technology that makes the screen flexible for viewing. Wikipedia describes it as "responsive design is a web development approach aimed at crafting websites to provide optimal viewing experience, simplifying navigation with minimal resizing and scrolling website across the wide range of devices".

2.18 Adaptive Website

In these types of sites there is not one layout that always changes. Rather there are several distinct layouts for multiple screen sizes and the layout used depends on the screen size used i.e. specific layout for mobile phones, tablets, and desktop computers each of which are made in advance defined by Vincent and Ashman et al (2013, [30]).

2.19 Difference

Both of these sites have the common goal is to provide the visitors a better viewing experience by allowing the websites to be viewed in mobile devices with various screen sizes. But the two methods differ in their delivery of technology.

Difference between responsive and Adaptive websites are given below:

SL	Responsive	Adaptive
1	Responsive website completely relying on flexible and fluid grids on screen sizes	Adaptive loading based on predefined screen sizes for example 800x400 pixels or 80% width and 100% height [3].
2	Responsive website use CSS and flexible foundations	Adaptive use streamlined, layered approach
3	Responsive website it take little longer to load on browser	Requires CSS loading time compare to Responsive Website
4	Responsive sites can accommodate new viewports	Adaptive requires to addition of new viewports according to new display profiles

5	Responsive design comparatively more difficult because development requires extra attention to the site's so that it functions well at any possible size.	But adaptive design has much more flexibility by making different layout for different screen.
6	Responsive sites are guaranteed to work well on any screen size	But sometimes the adaptive site shows the best display for a specific of screen size
7	Whenever a new screen size is released there is no worry	A new layout required to develop for a new adaptive site.
8	Responsive website are smart enough to work on the screen based on runtime decision	Adaptive sites may require some special maintenance
9	Responsive sites there are some pre checking about the screen specification, size and based on that the appropriate layout is than loaded	Adaptive sites load faster as because there is no pre checking before the loading
10	The coding of responsive site is some complex.	Adaptive site coding is simple
11	In the responsive sites the contents are shuffling based on the screen based on fluidity feature so responsive website requires pay particular attention to the visual hierarchy of the design.	But this does not happen in adaptive sites
12	In responsive design the same HTML and CSS code is delivered to the client host	Adaptive design the server first detects the devices making requests to it than based on that its loaded HTML and CSS [3].

13	Responsive sites are works on client side meaning the server provides the contents and the client's browser then rearrange those using media queries.	Adaptive sites are server side meaning the server first detects the clients screen information and then it provides the layout which is best suited for the screen.
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The results of the load time of responsive and adaptive sites is given below collected from an online article published by Matthew Harris (2015, [31]) titled "Responsive or Adaptive Design – Which is Best for Mobile Viewing of Your Website?"

Metric	Responsive	Adaptive
Response	1,202 ms	568 ms
Document Complete	4,086 ms	1,536 ms
Website Response	4,860 ms	2,889 ms
Bytes Download	4,229,362 kb	2,474,326 kb
Objects Download	61	20

1.19 Summary of responsive vs. mobile first

Ethan Marcotte in a (2014, [31]) article title "A List Apart" describes that responsive design is the way to adapt website's layout for the different screen size by using fluid and grids. So that it works multiple devices and looking similar on a phone, tablet or laptop device. On the other hand, there are lots of different idea about the mobile first approach some of them proposed different sites for different devices. Some of them also propose native apps that will solve that problem for instance for apps for an iPhone and Android.

1.20 Conclusion

The users who are accessing the websites into their mobile devices or other display screens don't care about what method are used here and it is true that if they have some way to know but nobody will agree to understand it. They only wants that the site they access should be give then same feel on whatever device they are using. In such scenario the responsive website is highly recommended and effective solution to provide best solution so that user would have optimal experience form the website. Although there are some disadvantages for the responsive website but those can be minimize by emphasis on the design and development stages.

Chapter 3: Requirements Analysis

3 Project Requirements

3.1 Functional requirement:

The requirement that must be exists in the system is functional requirement. Jeffrey (2010, cited from System Requirements Analysis - Page 131, [32]) defined “without functional requirements the system is not acceptable to the stakeholders”. The functional requirements of the proposed system are below –

- The system should be user friendly for online users
- Customer can surf their required types of room or apartments through this system
- Features of each room is associated with each category
- The system shall enable customer to check the availability of rooms, room details, price tags etc.
- The customer can be able to book the room through online
- The room/apartments are placed in order so that they could be easily find out
- The customer can able to make online payment for booking room.
- System will acknowledge about the payment of the customer
- The system allow any cancellation or amendments of bookings
- The online payment module should be secure enough and maintain international card security standard
- The system internal user be capable to view the bookings details
- They must have access to respond the customer queries
- The managers can access system reports and figures
- The administrator can login into the system with separate URL
- The administrator can update the site with latest information
- The administrator can update the security features of the system from time to time

3.2 Non-functional requirements:

Non-functional requirements are not mandatory for a system but their existence enrich the system usability defined by Jeffrey (2010, [32]). The following non-functional requirements have been identified.

- The GUI should be nice, clear and match the company brand view
- The website support with promotional material
- The sites should be compatible with all internet browsers
- The client side should be capable enough to perform input validation. It is better to minimize the amount of information sent to the server

3.3 Project Plan

Project plan is very important things that require developing a project and success of a project mainly depends on proper project plan. According to Gereth (2015, [33]) "Project Planning is a strategic description that describes step by step to complete entire project". It is also define the resources, time line duration, human resources requires completing project. Project plan is the initial stage of a development project used for planning assumptions and decisions, simplify communication among stakeholders and document for reasonable scope, cost, and schedule baselines. Initially it defines the input of the project based on project character and concept of the project proposal. Planet planning phase encompassed of project requirements, scheduling and project management plan. The proposed project has developed based on the following seven project management phases defined by Gereth (2015, [35]) are given bellow

1. **Project initialization:** This is the first stage of any project plan where stakeholders define plan for project scope, aim and objectives. After that it is assigned to Project Manager and Project Supervisor to successfully complete the project.
2. **Planning:** After project initialization project manager conducting with his team and defines project plan and produce complete grant chart, time allocation, resource allocation, human resource allocation is the part of this phase.
3. **Requirement analysis:** Requirement analysis is very important factor for project development. Proper requirement can identify what is requires to develop and their aims and objectives. Also its defines what exactly users are expecting from the proposed project or the project.

4. **Design:** After the requirements phase design and development are start. In this phase requirements are accumulated together and then split themselves as much as possible and develop the project step by step using project plan.
5. **Graphics:** If it is website design or even product design project it is very important to design proper user interface and this tasks are performed in this stage. The graphics are the front end of the product that the end user will see moreover well designed graphics highly attract the customers and increase usability of the project. The graphic designer are developed the artwork and approved from the stakeholder.
6. **Testing:** Testing help us to identify defect of any product before release any product it requires to test properly and identify faulty and resolved them before release. Testers are responsible for these tasks but developers can also perform this tasks using code testing for example Unit Testing, Nunit testing etc.
7. **Release:** After successfully complete previous all the tasks and testing product are ready to release for the users. Project plan at a glance of the proposed project are presented on the following table

S/L	Task Name	Start Date	Finish Date	Day	29-Feb-16							7-Mar-16							14-Mar-16						
					M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
1	Identify stakeholders	2/29/2016	2/29/2016	1																					
2	Determine project scope	2/29/2016	3/1/2016	2																					
3	Define preliminary resources	3/1/2016	3/1/2016	1																					
4	Determine requirements with stakeholders	3/2/2016	3/4/2016	3																					
5	Seek stakeholders' approval and feedback	3/7/2016	3/7/2016	1																					
6	Review preliminary software specifications	3/7/2016	3/7/2016	1																					
7	Develop functional specifications	3/8/2016	3/9/2016	2																					
8	Develop non-functional specifications	3/10/2016	3/10/2016	1																					
9	Develop code	3/11/2016	3/14/2016	2																					
10	Accumulate graphics into the system	3/15/2016	3/15/2016	1																					
11	Integration Testing	3/16/2016	3/16/2016	1																					
12	Modify code	3/17/2016	3/17/2016	1																					
13	Conduct training	3/18/2016	3/18/2016	1																					
14	Deploy software	3/18/2016	3/18/2016	1																					

Figure 11: Project Plan

3.4 Business Process

The following figure shows a high level overview of the site and its business process and business workflow. There is different party of the website whose area of tasks is different. Both of them are interrelated with the system. The following business process diagram has produced based on Trinity Saint David University Student Accommodation booking system discussed with accommodation's admin.

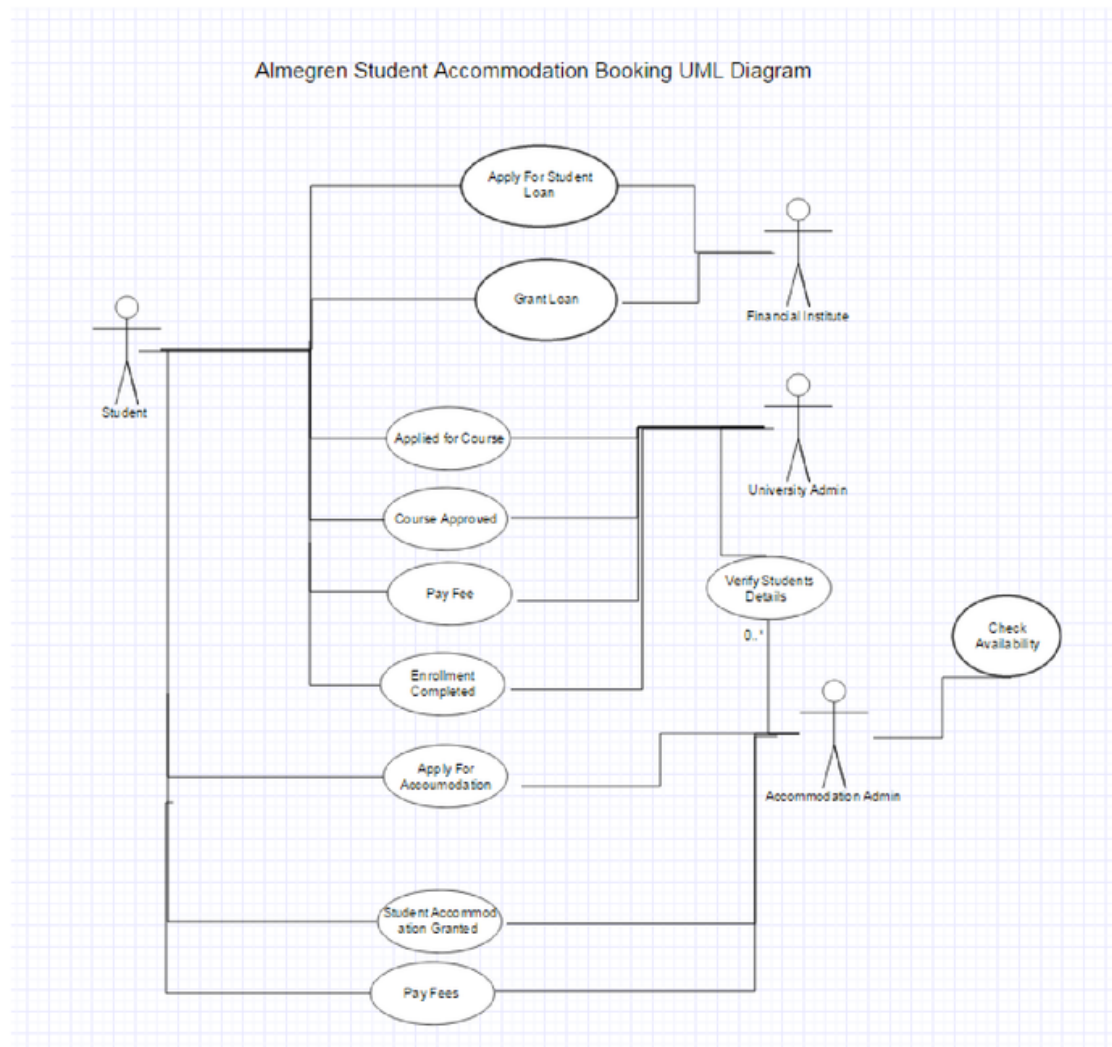


Figure 12: Business Process Diagram

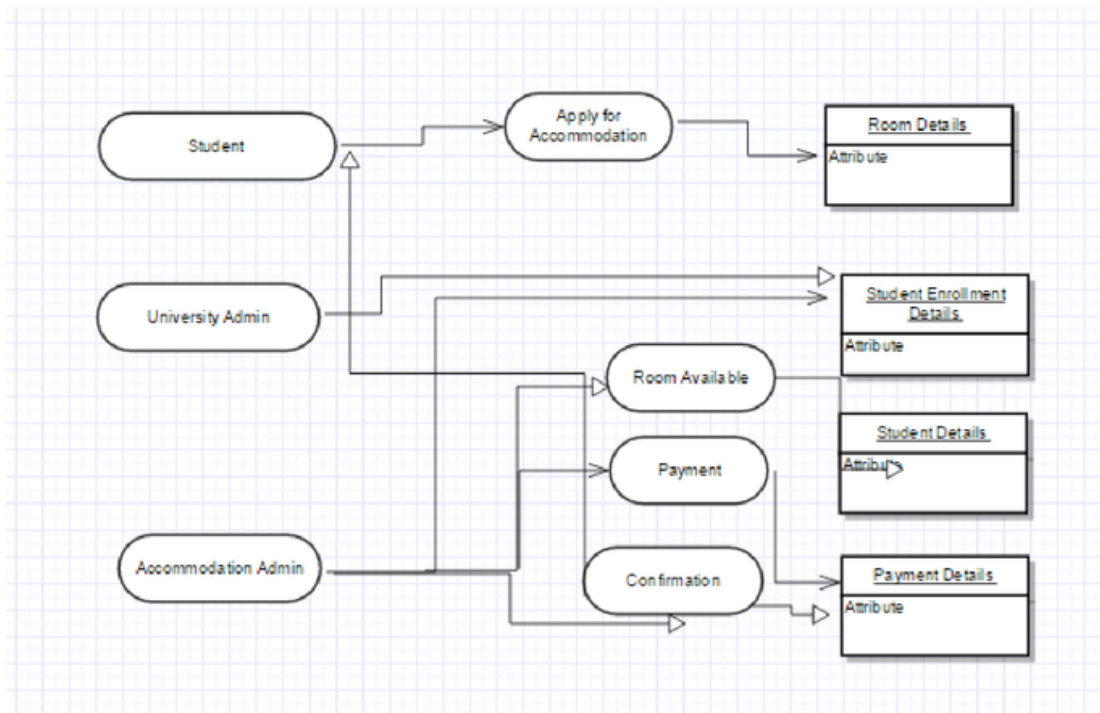


Figure 13: Business Flow Diagram

3.5 Activity Diagram

Activity diagram shows activities user would perform into the proposed accommodation booking system from beginning to end.



Figure 14: Activity Diagram

Chapter 4: Software Development and Methodologies

4.1 Introduction

In software engineering, there are several groups of people works together to develop and application for ease the operations. Since here are several groups of people working together so they have to maintain a process which will splitting the overall software development work into specific phases and it clearly describes the individual activities as well as the phases of activities intending for better planning and management. This process is known as software methodology. The methodology process defined by José and AlpeshKumar et al (2011, [33]) on their book "Software and Data Technologies: 4th International ... - Page 60"

"... It eases the process of development and brings the overall working activities into a structured framework" There is lot of different types of software methodology using in the software industry. Moreover, one methodology is always not necessarily suitable for all projects".

Generally it depends on the kinds of projects, based on different criteria including various technical, organizational, project and team considerations etc. Here is given some most common used methodology in the software industry.

4.2 Waterfall model

Linda (2008, [34]) described waterfall model is the oldest model used for software development and It is also known to as linear sequential software model. Waterfall model is very simple to understand and use. Here the whole software development activities are divided into different step called phases and each phases are separated from other and a project to be successful each phase must be completed before the next phase can begin. There are no overlapping activities between the phases. Typically, the outcome of one phase is used for input for next phase. The waterfall method is most appropriate where the requirements are wen documented and it is defined clearly and fixed, the product definition is stable, the project is short, the technology is not dynamic and there should not be any ambiguous requirements. Waterfall model allows for departmentalization and control of the software development activity. Here a schedule is set with deadlines prior to each stage and the activities proceed one by one.

The most disadvantage of waterfall method is that it does not allow repetition of any step and no requirements cannot be include once requirements had documented that why it is waterfall. So when the application is in the testing stage, it is very difficult to step back and include any change was not documented in the requirement and analysis phases.

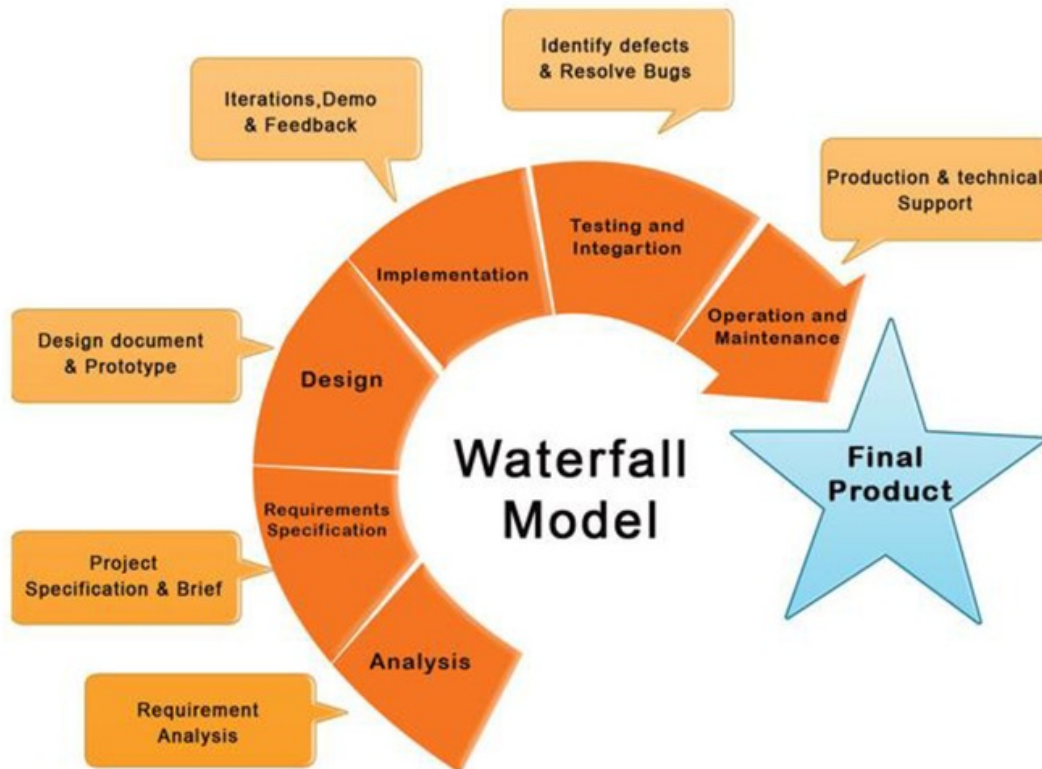


Figure 15: Waterfall Model Linda (2008, [34])

4.2 Spiral Model

Kim and Chan (2008, [35]) described the Spiral model is a combination of waterfall model and iterative development process. Since this model has high emphasis on risk analysis, so this model often referred to as risk-driven model also. During the life cycle of this model it has four phases where the software project continually passes through these phases in iterations called Spirals. The first phase starts with collecting and analysing the business requirements by continuous communication between the system analyst and stakeholder. The second phase is the design phase where the system architectural, logical and physical design was completed. In

the third phase the actual software has been developed. After those phases are analyse feasibility and management risks. Spiral Model is widely used by the software development industries for medium to high risk projects where there is a limited budget constraint and heavy risk involvement. Here it is assume that the when customer is not very much sure about their requirements then requirements begin more complex.

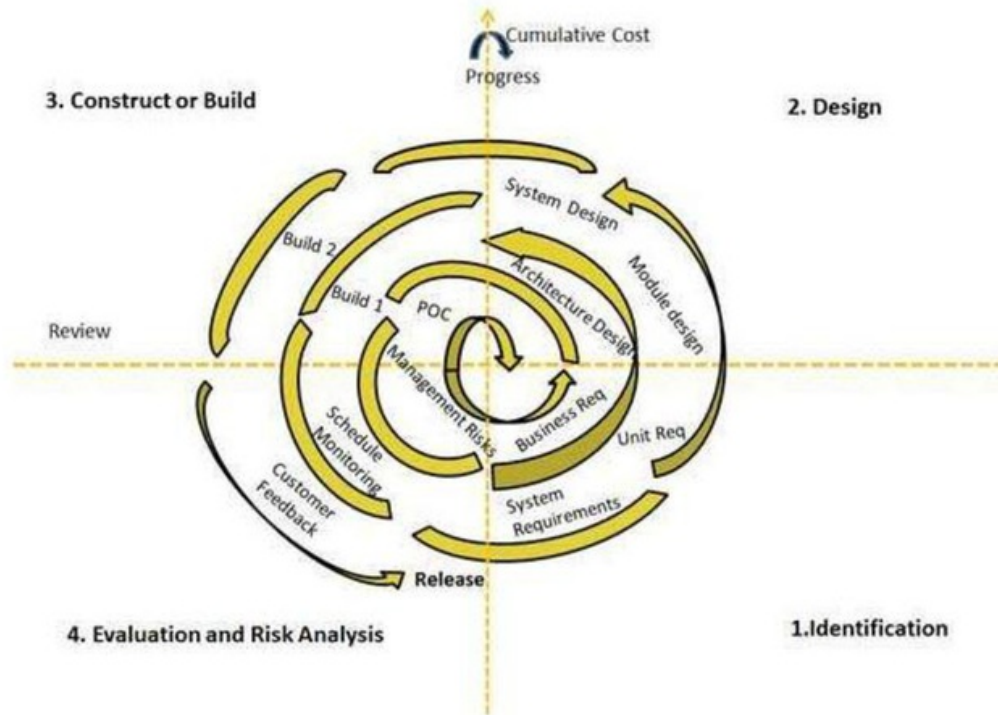


Figure 16: Spiral Model Kim and Chan (2008, [35])

4.4 Iterative Model

In the iterative model partly of the software developed first as per the requirements. Like the other software methodology here it is not started a full software with all specifications of the requirements. In this model all the requirements are divided into various builds. Kurt and Donald (1999, [36]) described iterative model where the developer then begins to implementing just only that part of the software. After implement it is reviewed for identifying whether the requirements have been successfully implemented or if there are further requirements then it will be incorporated in the next iteration. But in every cycle it is passes the requirements, design, and implementation and testing phases. Thus the subsequent release of the software adds the

functionality that were absent in the previous release. This process is continuously repeated until the full software is developed as per user requirement.

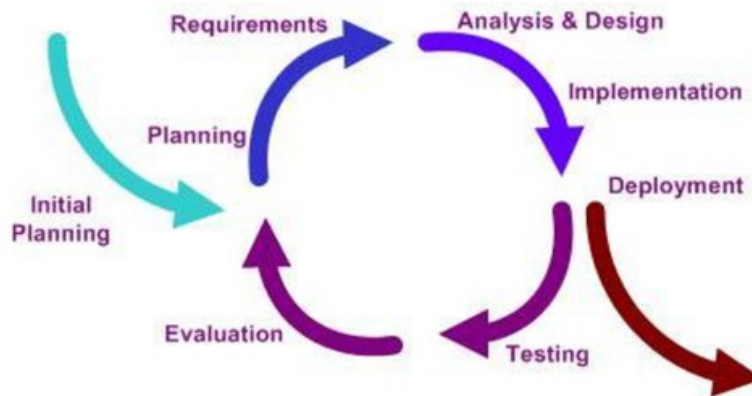


Figure 17: Iterative Model

4.4 Justification of chosen software development methodology: Iterative Model

After considering the above methodology it is chosen iterative model for the proposed software development. Since here, in this report there will be developing a website under two different methodologies so this model is the best choice. The justification behind the choice of iterative model is given below.

- It is best suited for large and critical projects especially
- In this model the software functionality can be developed quickly
- Here the results are obtained periodically in each cycle
- Individual cycle wise software development progress can be measured
- Less operational time to develop
- Customer feedback gets early on which the changes will be done in the next iteration
- It can be planned for parallel development
- Requirement changes would be less costly
- Testing and debugging can be done easily at every iteration process
- Better risk analysis and easy to manage risk
- Risks are identified and resolved during the iteration

4.5 Disadvantage

- It requires extra more resources
- In iterative it is very easy to change, include and update requirements but that associated with some extra cost
- Management have to keep close eyes on the every single iteration
- Another disadvantage of the iterative method is not all the requirements are collected from the beginning of the project lifecycle.
- Defining increments may require definition of the complete system.
- Iterative development method is not very stable for small project however, due to time limitation and rapid requirement changes happened during the development of the proposed project that's why iterative methods work very well.
- In iterative method project management is more complex compare with Water Fall or Agile Method
- Highly skilled people requires to complete the project and lot or risks involved in iterative method
- Success of the projects is highly depending upon the risk analysis phase.

Chapter 5: Research Methodology

5.1 Introduction

Accordant to Hammersley (2013, [1]) “the word research refers to find out some useful information on a precise topic through a logical and systematic search”. It is done in order to search for knowledge i.e. to discovery the hidden truths. Research is not limited within science and technology only rather its area is vast in other sectors also. Thus the prime objectives of research includes to discover new truths, to analyse and verify the important facts, to identify the cause and effect relationship and above all to develop new concepts and theories to solve and understand an unknown problems in our everyday life.

Like some other methodology research has also several methodologies to solve a problem. It is a science of studying how research is to be carried out. The researchers how to go about their work of describing, explaining and predicting phenomena are called research methodology. Its aim is to give the work plan of research. So the researcher must have sufficient knowledge about the research methods but also the methodology. In this report there will be given a brief overview of different research methodology and after that choose the best one which is suited for this proposed report with necessary justification.

5.2 Sources of Data

Briney (2015, [37]) cited on his book Data Management for Researchers: Organize, maintain and share your data, page 23) that Researchers are using data for their research. This data can be of two types.

- **Primary data:** This types of data are gathered by the researcher themselves through surveys, interviews or having some other methods. Since these types of data are collected for the specific purposes so sometimes researchers make some restriction when publishing it. This project gathered primary data as part of the evaluation.
- **Secondary data:** These types of data are published by someone else for their own purposes and have been kept as historical records. There searchers arouse such data to investigate new facts insights into it. This research used secondary data in the literature review and other parts of the report.

5.3 Research Methodology

Kothari (2004, [38]) describes There are different types of research methodology used for research based on research type. It is the researcher who chooses the specific methodology based on his requirements. In a certain research the researcher can use either some specific methodology or a mixture of different methodology.

- **Qualitative:** This type of research is primarily empirical research. It provides details of specific situation using different research tools. The researchers use it to get understanding of underlying reasons, opinions, and motivations since it helps to uncover trends in thought and opinions, and dive deeper into the problem. The data collection methods use here varied between semi-structured or an unstructured technique.
- **Quantitative:** This type of research is used to quantify the problem using numerical data from several sources and then transformed them into useable statistics. It generalize the result from a larger datasets using some known variables like opinions, attitudes, behaviours or other defined variables. Basically quantitative research discovers facts or uncover new patterns using some measurable. The data collection in quantitative methods is much more structured than qualitative data collection methods.
- **Correlation/Regression Analysis:** This type of research used for determining the relationship between independent variable and one or more dependent variable. In this methodology it is assumed that both variables having some relationships within themselves. The values of such methodology are always between -1 and +1. There is correlation between the variables.
- **Meta-Analysis:** This type of research methodology is useful for discovering the average impact of several different studies on a hypothesis. It is a statistical technique for combining the findings from independent studies.

5.5 Research Methodology Tools

Sing (2013, [39]) describes following research tools in his books are bellow

- **Interviews:** Interview can be defined as a guided conversation between a researcher and somebody else. Interview structure can vary but the general interviewers follow a semi-structured format. Here the interviewer first develops a guide about the topics on what would be the conversation during interview. But the interviewer can apply any of the strategy for the purpose of interview. Thus interview is a very good tool for gather detailed information where researchers is open ended to collect range of information.

However, interviews are not particularly suitable for gathering information from large numbers of people group. It is also very time-consuming matter to interview individual.

- **Questionnaires:** Questionnaires are the best method to collect standardized information from a large number of people. Questionnaires are very suitable to collect qualitative and quantitative data but it requires great deal of care to design and delivery the process. But questionnaires are best suited for a research that seeks to measure some parameter for a group of people and make comparison among the group. Questionnaire may of different types including self-completion questionnaire.
- **Observations:** Observations can be done in both quantitative and qualitative research. When the researchers want to know about people behaviour under certain circumstances. It is good for medical or scientific research. Observation can be of systematic manner when the researcher set the participants in some strict setting and after that observe their behaviour, listen their conversations and ask questions.
- **Survey:** Survey may be factual, inferential or exploratory. This may start with an idea and try to prove it by collecting information and see what emerges. Surveys are usually pre-tested on a small sample before being used more widely. It is less useful if the intended outcomes against the individual experience in detail. But it is widely useful when the expected outcome depends on gathering data from different people and the formulation of questions be simple.
- **Case studies:** In this type a case has been taken and studies it in detail. Then draw out the more general lessons for wider application. Although a case study cannot prove a theory, it can be used to disprove one if the data from the organization do not fit the theory.
- **Documentary Analysis:** according to Sing (2013, [39]) "It refers to obtaining data from existing documents without involving people to questionnaires, surveys or observation". Documentary analysis is the main way that historians obtain data about their research subjects; basically data is collected from previous research work that can be collected from questionnaires, surveys or some other data collection techniques. Document has a great value for the scientific project, government organization to make a result based on historic data or data trend.

5.6 Onion Research:

There are sets of procedures which can help us to carry out research and produce result.

Research onion is a one of the best and systematic study that guide to research to be successful. For the proposed project onion research has considered as a core research methodology. There are some layers that used to conducting this study. The main layers that applied in the proposed research are given below:

5.6.1 Research Philosophy:

Saunders and Lewis et al (2009, [40]) defined "Research philosophy is a brief description of collecting, analysing and interpreting that row data that have been collected". Most significant part of philosophy is that radical humanistic, functionalist, pragmatic, objectivist, subjectivist, realism and positivism.

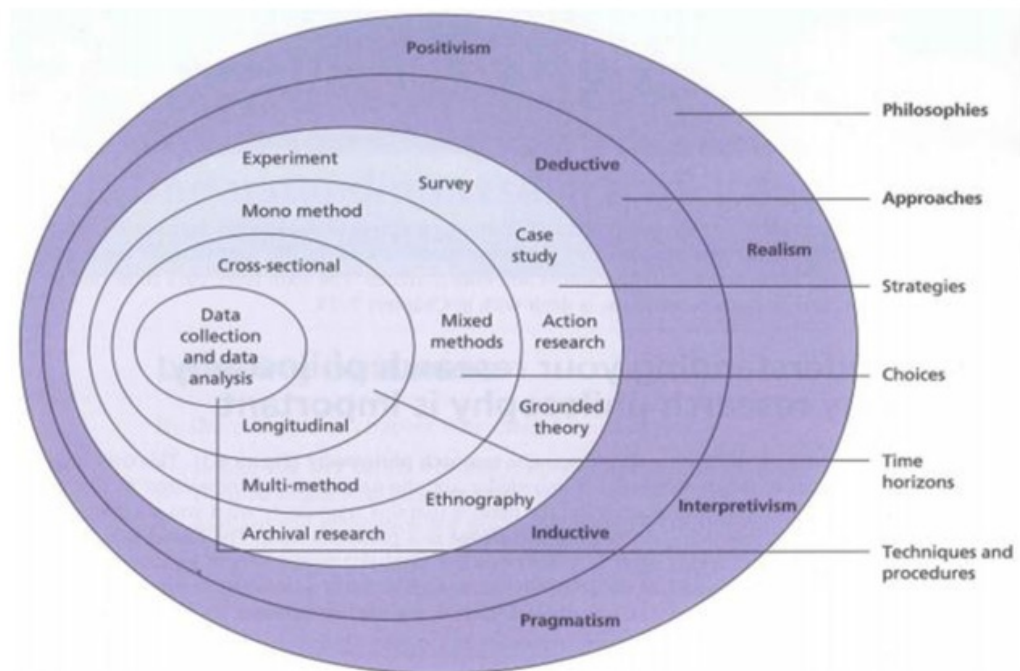


Fig: Research Onion Saunders and Lewis et al (2009, [40])

5.6.2 Research Approach:

Research approach is the second layers of Sanders research onion method and it also consists of another four types of approaches are deductive, qualitative, inductive and quantities. In

deductive approaches the theory and hypothesis of the research are checked first then moving forward to specific result. But in deductive approach observation get most priority. On the other hand, qualitative research is mainly focus on the data collection method and here for the proposed project qualitative approaches has considered.

5.6.3 Strategy choice:

There are lots of strategies are available however; researchers choose their strategy based on their work types. But in general it could be grounded theory, case study, ethnography, survey, action research and experiment. For this project work chosen survey work using predefined questionnaires.

5.7 Survey strategies and design features

5.7.1 Overview of survey

In the proposed report the objectives of the survey is to evaluate the website design architecture. First of all it was determined that the target group whom to survey and what are the areas to ask them. For each question it was planned before what will be the question and what are the possible answers. Based on that, the questionnaire is designed as open / closed answer. It is necessary to define unless the results will be not satisfactory and unproductive. J. Crawford (2001, [36]) cited form "The Strategic Project Office: A Guide to Improving ... - Page 110" the objectives should follow the specific, measurable, achievable, relevant and time-bound (SMART) rule. So it is also necessary to set goal prior to survey. There can be more than one objective for one goal statement. The goals of the objective are given below.

Goal: To identify how flexible the website develop, maintenance and testing in the mentioned two design

Associated objective: To assess developer's opinions about the two design techniques individually and identify which one is more convenient

Associated objective: To evaluate how the Search Engine react on different website architecture

Goal: To evaluate the general user experience about the proposed design techniques

Associated objective: To assess how the general users feel the difference when they access the sites is designed in different techniques

5.7.2 Timeline

Crawford (2001, [36]) defines "A timeline has to be set prior to survey in order to make it successfully". Here in this proposed report the timeline has been set as 2 weeks. Between these times the data will be collected and evaluated. Since the time provided is not sufficient enough so here only taken the answer only of the questions. The comment section is keeping for future analysis. The questionnaire is also keep simple and short in size. It will help the writer to take the actual result in short time and make analysis on it.

5.7.3 Target group

This report will evaluate the website design technique. Since the end users have no bother about the backend architecture of the site so they are not well aware of these techniques. They just want to access the site without any hiccup. Another common scenario for the aged persons while they accessing the sites. They don't differentiate the feel about the site. They only concentrate about the requirement and how well they fulfil it. So setting the target group there is two considerations and takes the answers in two different sets. The first one is the developer group who develop the site and the second one the general user who use the site. The age group of them is between 22 to 50 years around.

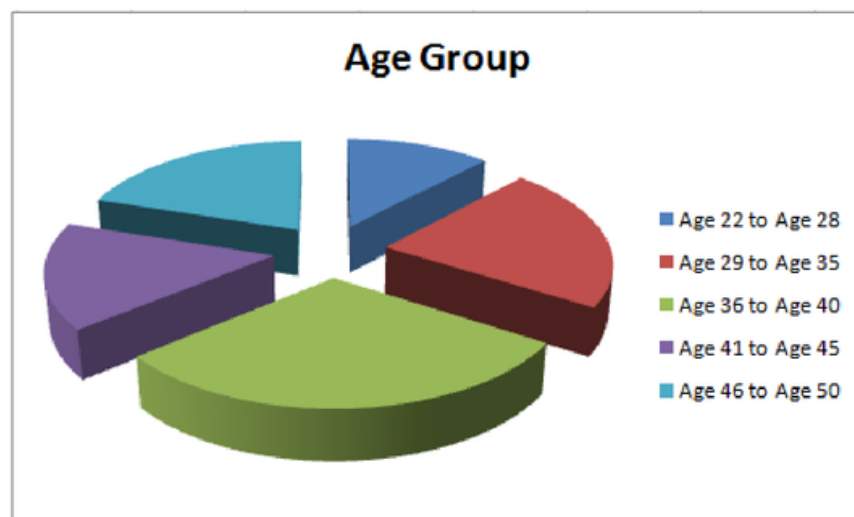


Figure 1: Target Group

5.7.8 Validity

In this proposed report it was consider several things while collecting data and making survey. The survey methodology was qualitative and there were data collection from both primary and secondary data sources. The questionnaire were set in such a way that the question ordering can be easy measurable, the question order, structure, format, visual layout was easy to understand and convenient for the responder and at the same time it was easy to accumulated the responds. This ensures that the survey results are valid and reliable. The questions are designed so that it reflects the issues that is researching and related to the proposed subjects.

5.7.9 Technology

There was a time limitation and hence it was not possible to conduct a mass survey. However the survey was conducted as much as possible within the local area. Moreover there was taken some online research survey which also strengthens the survey result. In this proposed survey the technology was chosen tablet. The questionnaire was placed in the tablet and the responder gives his opinion onto this instrument.

5.7.10 Limitation

In this report the writer was facing some limitations. The first one is the time limitation. The writer was provided with a limited time to research, design and develop the sites and. Within this shortest time it was really hard to complete the research to a mass area. There were another limitation was that the design architecture. Since the general user don't know and understand the architecture behind the front end they don't know the design architecture. So they only give respond the general access of the site. In such scenario the writer has to divide the questionnaire into two parts. One is for the developer and another is for the general user. Both of them response were then accumulated and generalize the research.

5.8 Methods and techniques used in data collection

In this proposed report the target is to perform an empirical research. It will be the goal is to identify details information about the responsive and adaptive websites i.e. the underlying benefits and demerits, the developer and users view against such websites etc. Considering the

above methodology it is chosen for the proposed research methodology is Questionnaire. Salvendy et al (2011, [41]) defines "Questionnaire is ease to use. It can be change according to user requirements". The because of this is

- Questionnaires are a useful method to investigate
- Relatively easy to analyses
- Users are already familiar with mobile website
- Relatively easier to collect large number of users opinion about the project
- Easy to analyse the data once it is collected on right format
- As a simple website has provided to user to give their opinion and feedback that makes data to stores in SQL Server Database and it is easier the represent result in graph.
- Information about the websites has collected in applying formal data collection strategies
- They are usually straightforward to analyses
- They can be used for sensitive topics which users may feel uncomfortable speaking to an interviewer about
- Respondents have time to think about their answers; they are not usually required to reply immediately.
- Large amounts of information can be collected from a large number of people in a short period of time and in a relatively cost effective way
- It can be carried out by the researcher or by any number of people with limited affect to its validity and reliability
- When data is analysed it can be use compare and contrast others research work

5.8.1 Disadvantages of questionnaires

Jolley,et al (2011, [42]) al concludes following disadvantages of questionnaires' are bellow

- Lack of data validation and data may not be collected in appropriate manner
- There are no option to say 100% accurate result can be produces even though data can be collected from multiple sources
- Respondent may not be fully ware about the subject and may give their opinion.
- The respondent may be forgetful or not thinking within the full context of the situation it may varies situation, their understanding level etc.

- People may understand of the deferent meaning of the questionnaires' and that will produce absolutely different result.
- When design questionnaires' researchers using their own decision but it may produce not all the question that is suitable for the project or researcher may missed some important question.
- It is also difficult to collect data from online resource and probably form postal or email based questionnaires.
- If people do not have proper knowledge of the subject matter may ignore question and may not feel comfort to answer the entire question correctly.
- Respondents may misunderstand questions probably because of poor and ambiguous questions
- If the surveys carried out too frequent it may be dangerous because user may respond based on their previous answer.
- They may require follow up research to investigate issues in greater depth and identify ways to solve problems highlighted.

5.9 Research Philosophy:

This is the first and most crucial step of knowledge formation and the character of the knowledge that was involved for the development. Research philosophy has highly impact on research strategy that helps us to determine the manner influence the research strategy and also method or plan that applied to the project.

5.10 Research Strategy:

Research strategies help us to execute the view of the project when it applied proper research philosophy. It is very important for a researcher to understand the manner of commitment to apply research philosophy and that have a great impact on project's scrutiny. After that various other factors and elements can help best result and ensure success of the research work.

Chapter 6: Result Calculation

6.1 Technology Comparison

In the survey there were divided the target groups into two sections. The first one is the development group. Since they develop the website design so they know better how they feel when to design the architecture. They also able to give their feedback, on the design will lead the future technology.

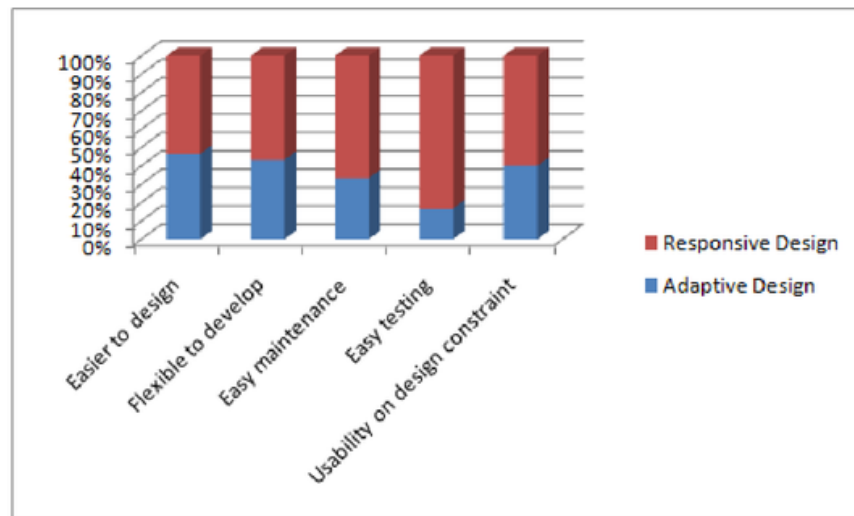


Figure 18: Technology Comparison

Particulars	Adaptive Design	Responsive Design
Ux design constraint	Few constraints	High content feature parity
Resource needed	HTML, JS and Server developers	HTML5, JS developers, CSS
Enabling technology	CSS, JavaScript, Server	CSS3
Implementation cost	Building alternative components	Content parity
Testing cost	Medium-high	Low-medium
Performance concerns	Depends on enabling technology	Significant
Maintenance cost	Low-medium	Low

6.2 User Experience Comparison

In the general user perspective they don't bother the technology behind the site. They become happy if they can access the site without any problem. It is a fact to them how they feel when they access the site in their different devices. In this perspective the general users are the second group in the survey. They were asked to give their feedback on accessing two website into their devices. One site is designed on adaptive and another site is designed on responsive technique. The general user groups were accesses these two sites into their devices in different web browser and respond accordingly. The below figure give an overview of their responses.

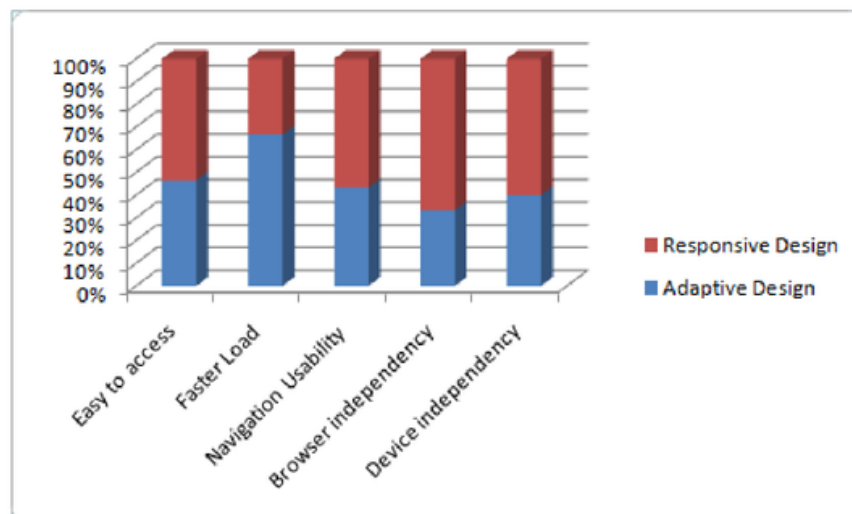


Figure 19: User Experience Comparison

Particulars	Adaptive Design	Responsive Design
Content parity	Content and feature unique across devices	Content and feature remain across all devices
Navigation	Optimized for each site	Navigation usability degrade from desktop to mobile
Pixel design	More control then responsive	Less control
Design layout	Design required for each major device type	Flexible design strategy

6.3 User Rating Calculation:

User provides rating for both websites after carefully investigated and used. The result has calculated as percentages for both website as bellow:

Initially, average of ratings has calculated by Total Rating given by user to total Number of user than it is converted percentage ratio because users has rated between 0-10.

Average of Website Rating = Total Number of Ratings for Responsive Website / Total Number of User.

Percentage of Rating= (Average Ratings / 10) x 100

For example total ratings for Responsive website 35 given by 5 users.

So average ratings = $35/5$

= 7

So percentage of ratings = $(7/10) \times 100$

= 70%

Percentage of ratings both websites are presented on pie chart are given bellow

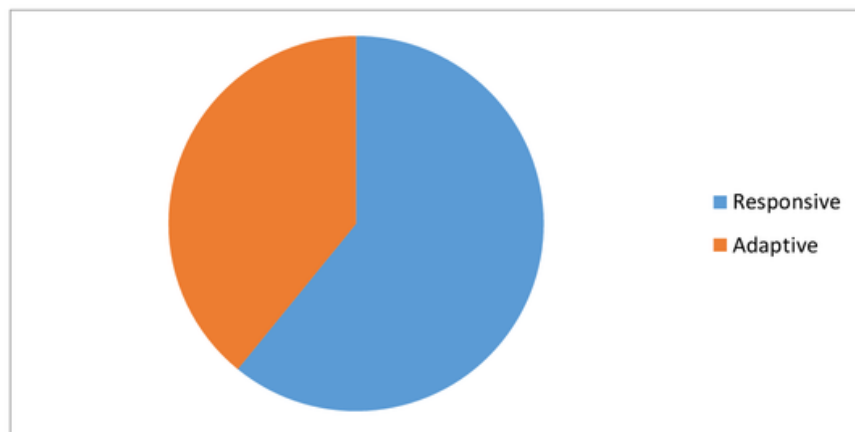


Fig: User rating ratio; Responsive VS Adaptive

Chapter 7: Testing and Evaluation

7.1 Home Page

Home page is the first page of the website which is the index page for web designer. It will provide all the information about the hotel and its activities. It should give detail information and attract users to be customers.

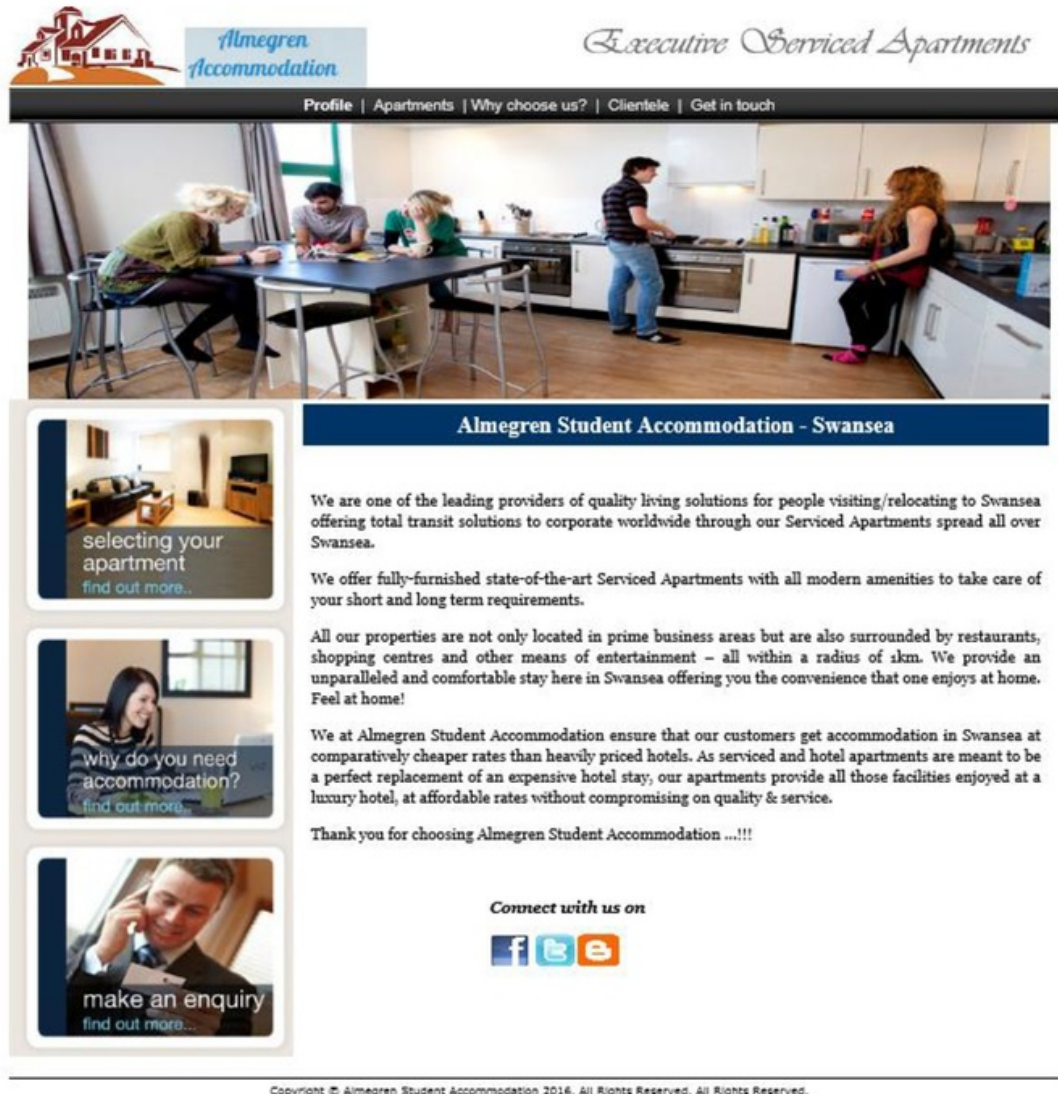


Figure 20: Adaptive Design Homepage

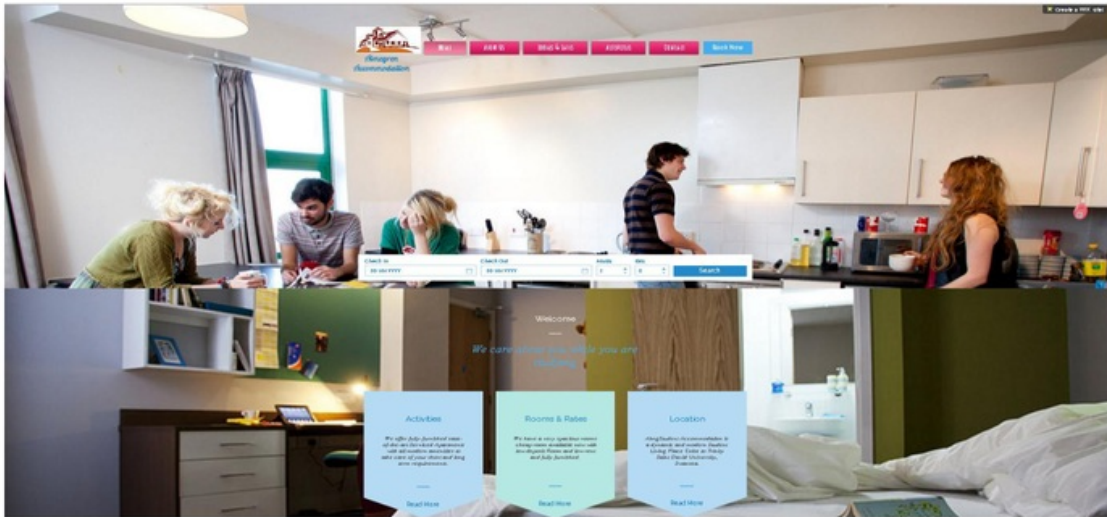


Figure 21: Responsive Design Homepage

1. Web link for Responsive Website
<http://azizalmg.wix.com/accommodation>
2. Source Code for Adaptive Website has included into CD – Simple HTML Page can be open any browser i.e. Google Chrome or Internet Explorer
3. Source Code for Survey Website has also included onto CD – System Requirements: SQL Server 2012 or upper version, Entity Framework 6.2 +, .NET Version 4.5 and ISS 7

7.2 Testing

After successfully development of a system it is needed to test prior to deploy into production. It is because to test the system in every aspect of user issue so that the system would act as per requirement though there is tested the system by the developer while developed. Here a particular tester acting on the system so that it would be error free. Moreover there is also tested about the input validation, form validation etc. The proposed websites were also tested in different aspect of view and the result is given below. The length scale of the result is set between 1 to 5.

Testing Method	Purpose	Responsive	Adaptive
Unit Testing	Test the individual bits of code so that everything is working fine	5	5
System Testing	Test the system is running smoothly. Since there is making pre decision based on display size so adaptive required more time to load.	5	4.5
Usability Testing	Test how much the user feel convenient when they access the system.	5	3.5
Acceptance Testing	Test the user accept the site.	5	4
HCI Factors	Test the HCI factors are working smoothly	5	4.5

Chapter 8: Evaluation

8 Evaluation

While designing the responsive site it was more difficult to design since it requires extra attention to the site's CSS. Whereas it's easier to make a few specific layouts for adaptive website instead of making one layout that can work in any screen size. Thus in concern of the development point of view adaptive design needs a bit of flexibility to work on several screen sizes compare with one layout that works for all of them.

Due to the wide variety of screen size sometimes it is found that the final results don't always display the best for adaptive design. But in such scenario responsive designs guaranteed to work well on any screen size no matter what would be the new coming screen resolution. So if a new device with a new screen size is released then there may chance to not fit the layout on the new screen which would not happen in the responsive design.

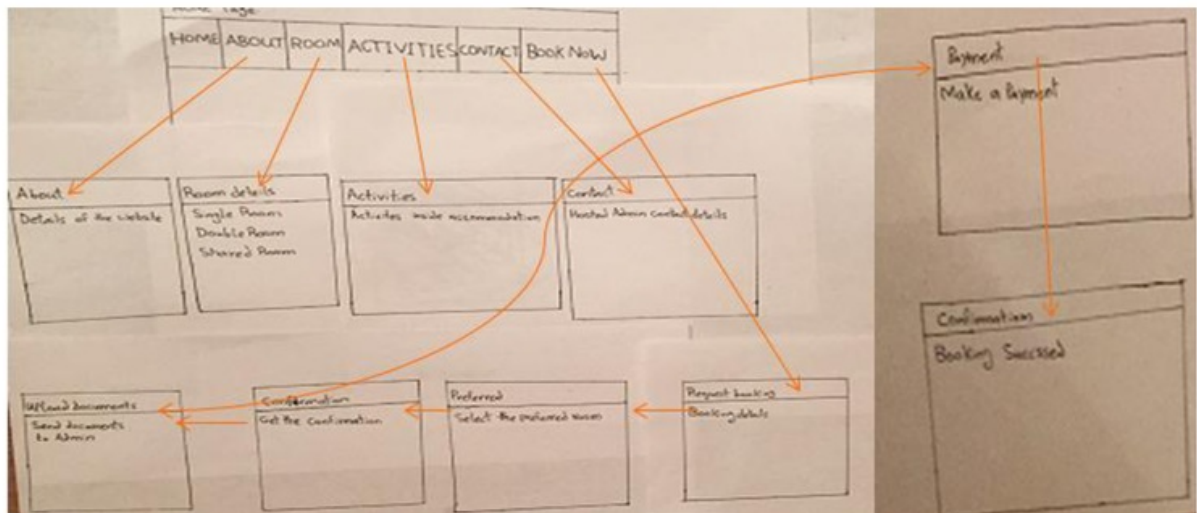
For the website loading times there will load all the possible layouts for adaptive design so it takes extra time and resources while responsive websites only need to load the one layout that works for every possibility. Thus adaptive site is a bit slower than the responsive site.

Katherine (2013, [42]) cited on this book "Computer Concepts: Illustrated Essentials - Page 14" an adaptive design creates unique experiences on both desktop and mobile without sacrificing quality though it is a costly process. Since there is created several layout so it would takes much time to develop. Also it becomes a continuous process because a new release requires a new layout. But in the case of responsive design it offers a similar user experience taking a little longer to load. Thus responsive design is less expensive.

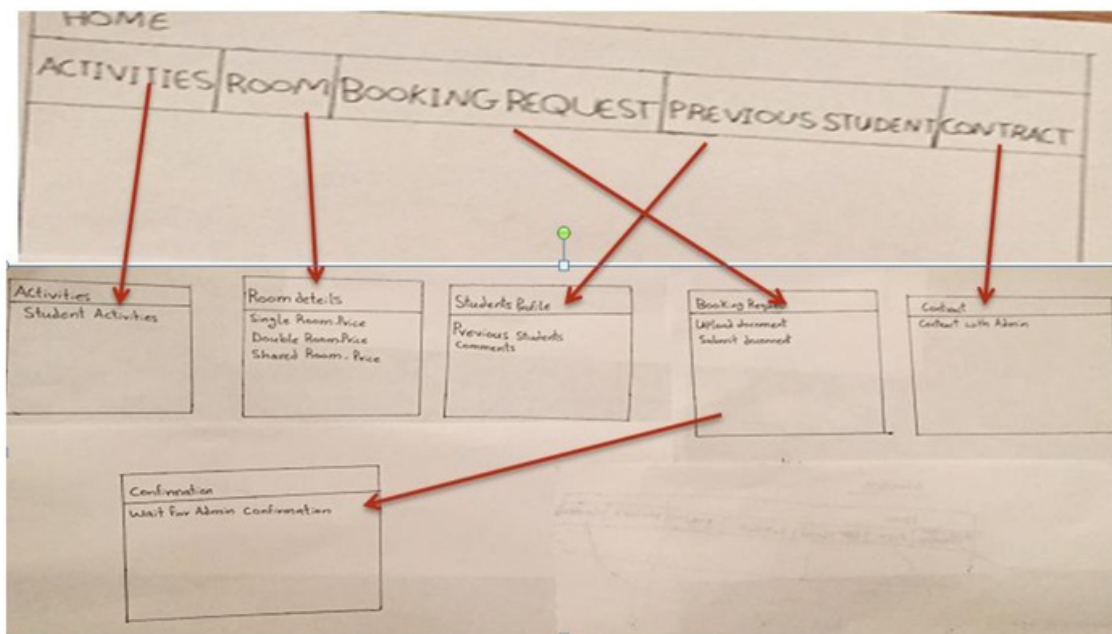
Considering the Search Engine Optimization issue a responsive design deliver the same HTML code which is not happen for the adaptive design. So the search engine like Goole makes it easier and faster search to index a responsive website.

8 Story Board

8.1.1 Responsive Website



8.1.2 Adaptive Website



8.2 Further Improvement and Limitations:

Today mobile based websites are growing rapidly due to advancement of technologies.

This project work's aims were comparative analysis of Responsive and Adaptive websites development strategies. To achieve the aims and objective of the proposed project there were two websites has developed using responsive and adaptive web design tools. The adaptive website has designed using simple HTML and CSS but on the other hand due to time limitation Responsive Website has created using online web design tool called wix.com. It is free for basic use and easy to create any business or personal website. But if the Responsive web site can create using CSS3, HTML5 and or Bootstrap CSS tool would improve the quality of the website. Also another website has created to collect user's opinion, response and feedback after use both websites called surveys website using ASP.NET, MVC and SQL Server Database to store captured data.

Once again due to time limit captured data has process and produced graphical representation of data using Microsoft Excel. But it could be done in ASP.NET website's graph design tool to represent real time presentation of data. In future it this project work can be extent to design Responsive website using proper responsive website design tools and ASP.NET graph creation can also be implement.

In the research methodology section it used Onion Method but couldn't complete all the phases for the limitation of time. So in further development it also can be apply all the phases recommended into Onion Research Method.

8.3 Conclusion

This report has introduced two different website design techniques responsive and adaptive using proper usability guideline.

After that a survey carried out to different users group (gender, age eg.) and to collect user opinion for both websites. Especially surveys captured user's behaviour, experience and their opinion about both websites. Than the comparative results has represented into graph to make it more understandable format.

Finally, result found that responsive is perfectly suitable not only for the mobile website but also for desktop or any website. It is working on any device without losing its consistency and usability. User's experience in responsive website is higher than adaptive website.

Chapter 10: Reflection

10.1 Experiences of interactions with mentor

First of all, I have found the advice given by my project supervisor is very helpful in terms of quality of the report specially she advised me similar research in the same field provided by provided me web links and referring me related books. Moreover, my Project Supervisor was not only highlighting lack of research and resources associated with my project but also provided detailed explanation of why those resources are necessary for my project.

Furthermore, I found these weekly meeting with my project supervisor was highly motivational and informative experience because topics I have covered and have to include was main issue. Also my supervisor provided me the details for the next week plan and that made my whole project work very easy and without having any default I have completed big work in a small amount of time.

Moreover, once again thanks to my supervisor I learned to appreciate the importance of strategic options available in the current web development field specially usability factors that are the most important things for a website or a project.

10.2 The extent to which research questions have been answered

First of all, my project work were divided into two significant fields the combination of development and research. To do so, I have to perform development and research separately. For the development I have developed two websites one is responsive using modern web development tools and technologies and another one is adaptive using traditional web design tools. Then came comparison between two websites and perform survey and to perform my survey I have created another website that captures details of survey, users information and their ratings for both websites.

Then come research questions in my Research Report were directly related to the quality of primary data, and the choice of methodology. Moreover, after that collected data has properly validated and finally produced the result.

The choice of methods for conducting the study, on the other hand, was guided by the reliability of the data analysis methods and their relevance to the research issues.

10.3 Interpersonal and communication skills and their relevance to the research

I have demonstrated my interpersonal and communication skills at various stages of doing Research Report and preparing for and making the presentation, perform survey. I have found my writing and communication skills have improved significantly. Also those communication skills play the most crucial role in terms of succeeding in personal and professional lives.

10.4 The potential contribution of Research Report to the level of professional development:

Conducting my Research Report and doing the presentation has increased the level of my professional competency in several ways. First of all, I have to mention the fact that I have developed 3 websites within very short time and that improved web development skills. I have learned usability guideline and human factors related to any product that would help me for my future career. I have also learned how to applying research methodology to perform survey was very much interesting thing for my project had improved my research and development silks. Moreover, I am planning to continue studying the issues of corporate strategy and that knowledge would benefit me in the future as a corporate leader.

10.5 Conclusions

To summarise, completing the Research Report and making presentation with Trinity Saint David University Business Information Technology course has increased the level of my preparedness to join the full-time workforce and successfully utilise my energy and knowledge. In my opinion the biggest benefit I received from this course I have significantly I have improved my skills and capabilities and they have also awoke my desire to approach studying as a lifelong process.

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Chapter 11: Appendix

Appendix A : Developers and Testers Feedback

General

Name: Abdur Rahman

Gender: ☒ Male ☐ Female Age: 23 Years

Occupation: Student

Do you use website: ☒ Yes ☐ No

How often you website: ☐ 0 7 times ☐ 0 ☐ 0

Very Rare Sometimes Daily ☒ Hourly

What device do you use: _____

Developer

Do you acknowledge of Adaptive/Responsive Website Design: Yes ☒ No ☐

Which design is easier to make: ☒ Adaptive design ☒ Responsive Design?

Which design is Flexible: ☐ Adaptive design ☒ Responsive Design?

Which design is easy to maintenance: ☐ Adaptive design ☒ Responsive Design?

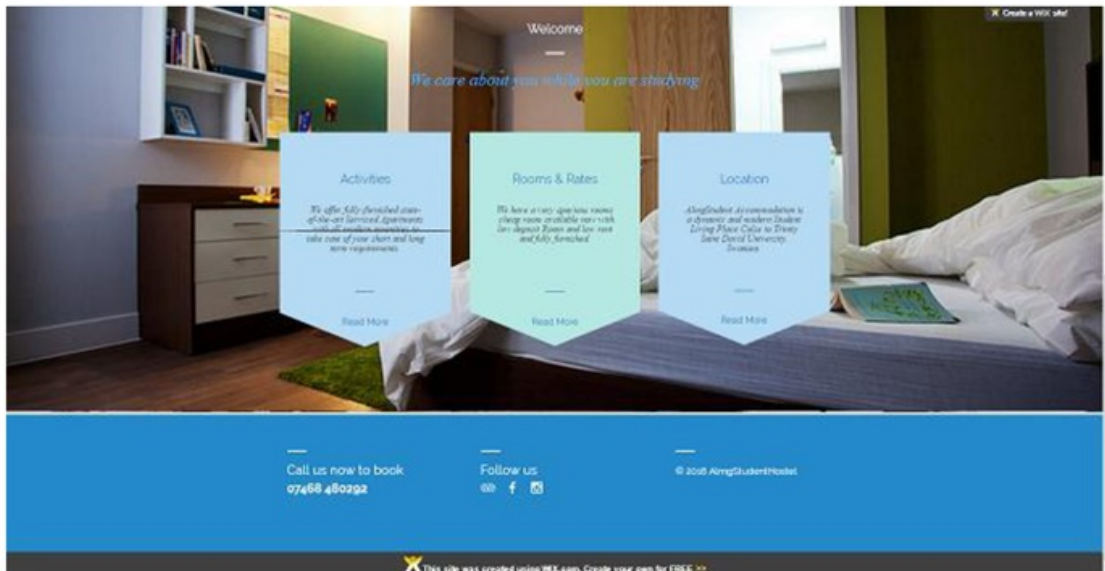
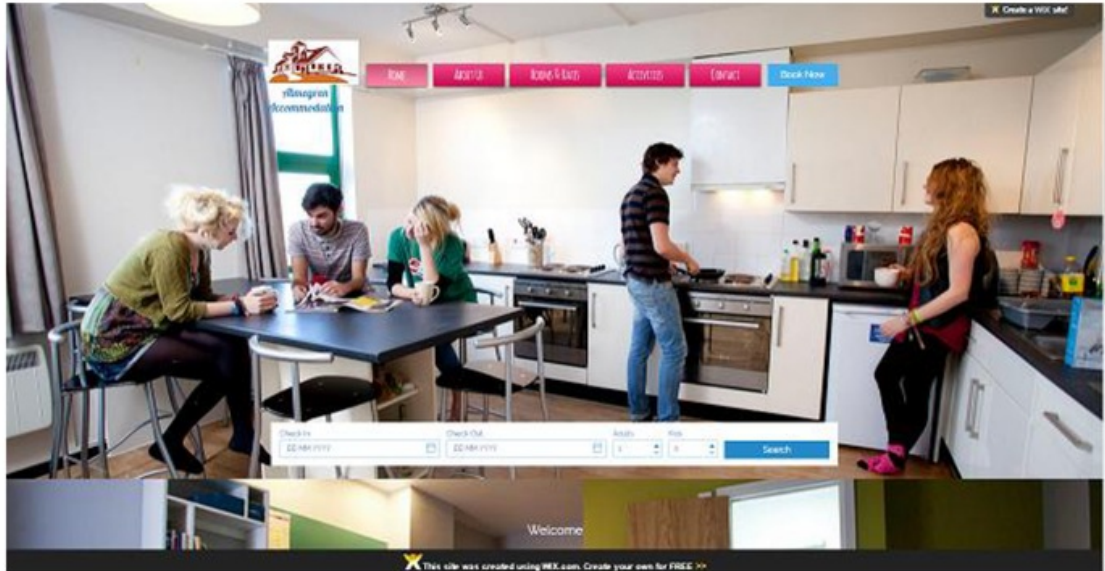
Which design is easy for testing: ☐ Adaptive design ☒ Responsive Design?

Higher user experience design constraint: ☐ Adaptive design ☒ Responsive design

Appendix 2

Responsive Website

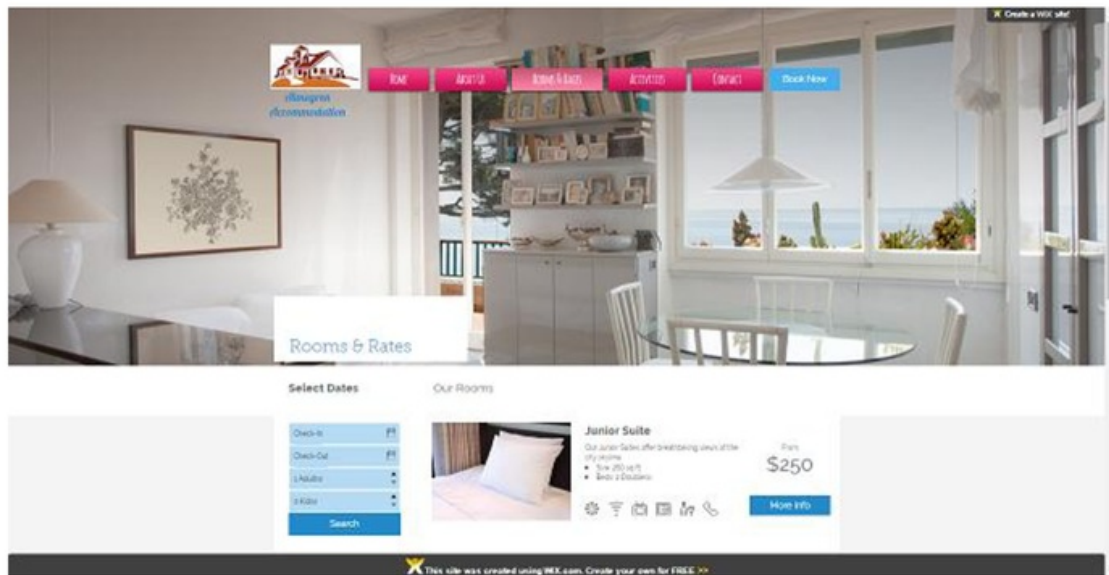
Home page



About Page:



Room Details Page



Activities Page:

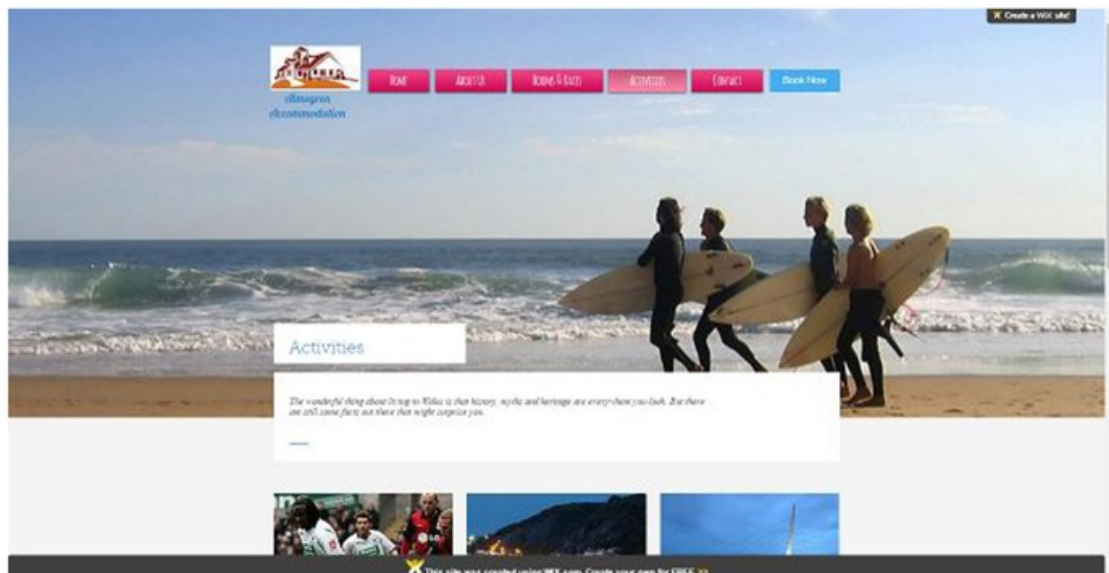
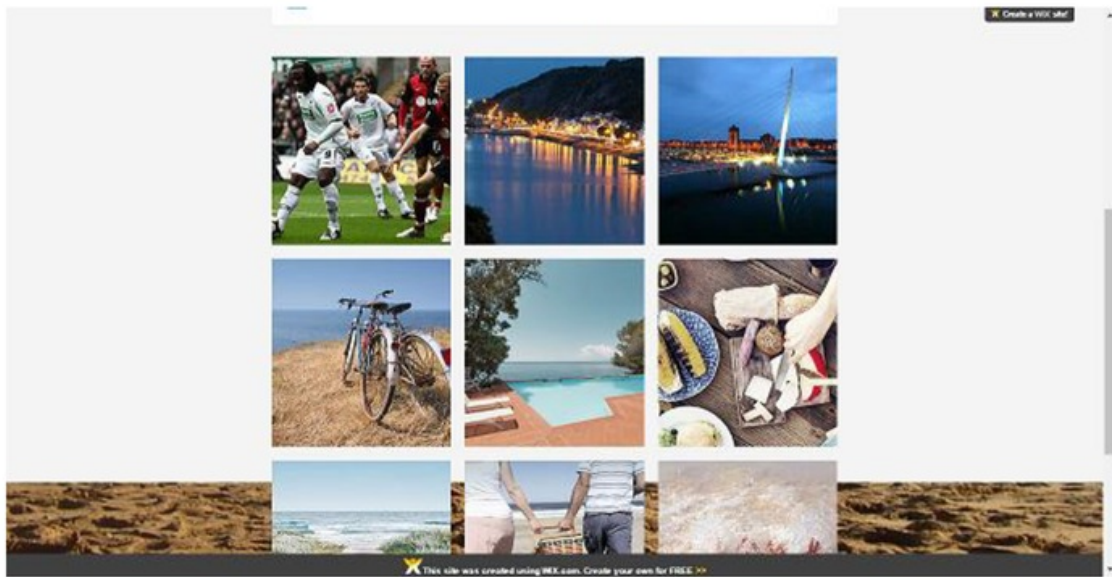
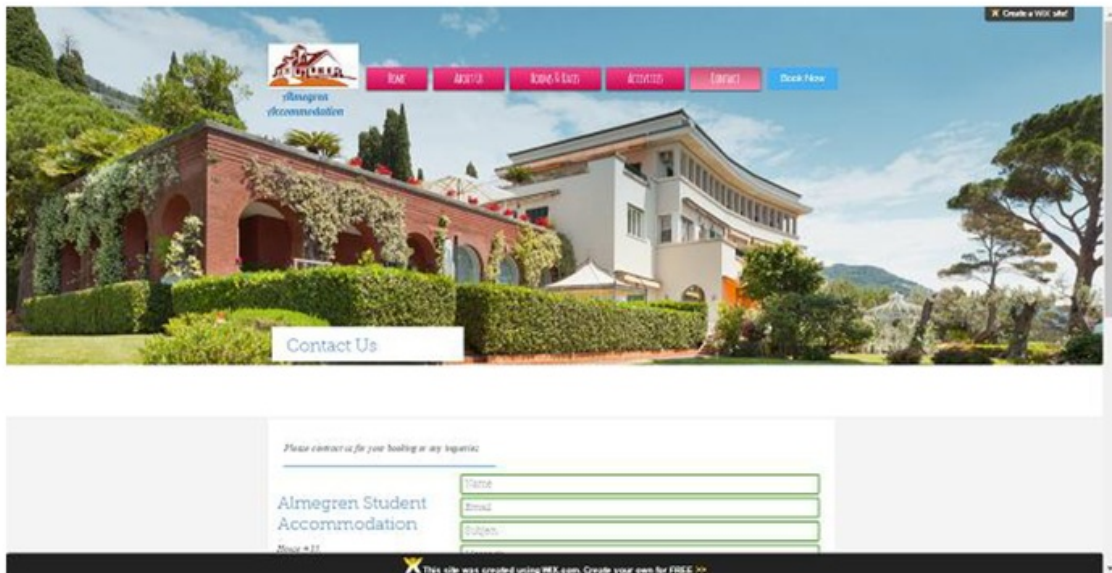


Image Gallery Page



Contract Page



Adaptive Website

Home Page

The screenshot shows the homepage of the Almsgreyn Student Accommodation website. At the top, there is a navigation bar with the following links: [Activities](#), [Choose a Room](#), [Send a Booking Request](#), [Students Profile](#), and [Contact with Admin](#). The main header features the Almsgreyn Student Accommodation logo on the left and the text "Executive Serviced Apartments" on the right. Below the header is a large banner image showing a group of students in a modern kitchen and dining area. Underneath the banner is a blue bar with the text "Almsgreyn Student Accommodation - Swansea". To the left of the main text area are three small images with captions: "selecting your apartment", "why do you need accommodation?", and "what our guests say". The main text area contains the following content:

We are one of the leading providers of quality living solutions for people visiting/relocating to Swansea offering total transient solutions to corporate worldwide through our Serviced Apartments spread all over Swansea.

We offer fully-furnished state-of-the-art Serviced Apartments with all modern amenities to take care of your short and long term requirements.

All our properties are not only located in prime business areas but are also surrounded by restaurants, shopping centres and other means of entertainment - all within a radius of 5km. We provide an unparalleled and comfortable stay here in Swansea offering you the convenience that one enjoys at home. Feel at home!

We at Almsgreyn Student Accommodation ensure that our customers get accommodation in Swansea at comparatively cheaper rates than heavily priced hotels. As serviced and hotel apartments are meant to be a perfect replacement of an expensive hotel stay, our apartments provide all those facilities enjoyed at a luxury hotel, at affordable rates without compromising on quality & service.

Thank you for choosing Almsgreyn Student Accommodation ...!!

Connect with us on

Below the text are icons for Facebook, Twitter, and YouTube.

Room Details Page



Almegren
Accommodation

Executive Serviced Apartments

[Profile](#) | [Apartments](#) | [Why choose us?](#) | [Clientele](#) | [Get in touch](#)



Almegren Student Accommodation Swansea

Our serviced apartments are located in prime locations and are within walking distance from Business centers, malls, shops and clubs.

We have a range of 1/2/3/4 BHK serviced apartments as well as bungalows in Swansea on a Daily, Weekly and Monthly basis. We also have special packages for long stays.

These serviced apartments in Swansea are fully furnished with all the basic amenities for a home-like comfort to make your stay a pleasurable experience.

Our serviced apartments are favoured by Multinational Companies, Firms dealing in Medical Tourism, Relocation Companies and business travellers.

Amenities at our serviced apartments include:

Our Profile Page



Almegren Accommodation

Executive Serviced Apartments

[Profile](#) | [Apartments](#) | [Why choose us?](#) | [Clients](#) | [Get in touch](#)



Why Choose Us

When you stay in a **Almegren Student Accommodation**, you get much more than hotel room. For around the same rate you would pay for a hotel room, you can have your own furnished apartment with a lounge, kitchenette and bedroom and still get the daily service you would in a hotel.

Why use a Relocation service?

Relocating can put the whole family under huge stress as well as *diminish* work productivity, besides incurring exorbitant costs. The service provider has the expertise in minimizing stress, coordinating a smooth and successful move and reducing many associated costs.

The benefits of using our service.

Our efficient professional service is friendly and thorough. Most of our apartments are located in prime locations and are within walking distance from Business centers, malls, shops and clubs.

Facilities and Activities Page



Almegren Accommodation

Executive Serviced Apartments

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Almegren Student Accommodation - Swansea



selecting your apartment

find out more...



We are one of the leading providers of quality living solutions for people visiting/relocating to Swansea offering total transit solutions to corporate worldwide through our Serviced Apartments spread all over Swansea.

We offer fully-furnished state-of-the-art Serviced Apartments with all modern amenities to take care of your short and long term requirements.

All our properties are not only located in prime business areas but are also surrounded by restaurants, shopping centres and other means of entertainment – all within a radius of 5km. We provide an unparalleled and comfortable stay here in Mumbai offering you the convenience that one enjoys at home. Feel at home!

We at Almegren Student Serviced Apartments ensure that our customers get accommodation in Swansea.

Contract Us page:



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Get in touch with Us

Almegren Student Accommodation

Call us on 07 468 480292

Email us at ataziz_almeg@btinternet.com.

OFFER STUDENT ACCOMMODATION AND GET HIGHER RETURNS

We are in the process of looking for apartment owners who would like to partner with us. If you have a property or a chain of properties that you want to affiliate with us, just email us at ataziz_almeg@btinternet.com.

Appendix 3

Survey website

Home Page: Surveys Result Page

Responsive VS Adaptive Website Survey

UserTables

Add Feedback

Responsive vs Adaptive

About

Index

Create New

UserId	Which Site Easy to use?	Which Site Sites Load Faster?	Which Site Navigation Easier?	Is it working on all browsers?	How Adaptive react with browser?	How responsive react with browser?	Your Choice?	Ratings for Responsive (0 -10)	Ratings for Adaptive (0 -10)	Comments	
1	Responsive	Responsive	Adaptive	True	True	True	Responsive	4	3	NA	Details Delete
2	Responsive	Adaptive	Adaptive	True	True	True	Responsive	10	6	Responsive Better	Details Delete
3	Almegren	Almegren	Wix	True	True	True	Almegren	7	8	Almegren has more information	Details Delete
4	2	2	2	True	False	True	2	10	5		Details Delete
5	wix	wix	wix	True	True	True	wix	10	8		Details Delete
6	Wix	wix	wix	True	True	True	Wix	8	8	very nice. works	Details

User Entry Page

localhost/Survey/UserTables/Create

Responsive VS Adaptive Website Survey UserTables Add Feedback Responsive vs Adaptive About

Create

UserTable

FirstName
 LastName
 Gender
 Age
 Occupation
 DoYouUseWebsite
 HowOften
 WhichDevice

[Back to List](#)

User Details Page

localhost/Survey/

Responsive VS Adaptive Website Survey UserTables Add Feedback Responsive vs Adaptive About

Index

[Create New](#)

FirstName	LastName	Gender	Age	Occupation	DoYouUseWebsite	HowOften	WhichDevice	
Abdul	Aziz	Male	23.00	Student	True	6	Samsung Galaxy Tab 4	Edit Details Delete
Faisal	Almegren	Male	23.00	Engineer	True	2	Samsung Galaxy Tab 4	Edit Details Delete
Syafiqah	Azhari	Female	21.00	Student	True	1	Phone	Edit Details Delete
Yousif	Aljassim	Male	21.00	Student	True	0		Edit Details Delete
reem	al-shalabani	female	22.00	student	True	1	laptop	Edit Details Delete
Sam	Njoroge	M	22.00	Student	True	1	mac	Edit Details Delete
Irfan	onur	Male	19.00	Student	True	24	android, pc , laptop	Edit Details Delete
Zaffer	Azad	Male	30.00	Graphic Designer	True	1	laptop	Edit Details Delete

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Survey Page: User Ratings:

localhost/Survey/FeedBacks/Create

Responsive VS Adaptive Website Survey User Tables Add Feedback Responsive vs Adaptive About

Create

FeedBack

Which Site Easy to use?

Which Site Sites Load Faster?

Which Site Navigation Easier?

Is it working on all browsers?

How Adaptive react with browser?

How responsive react with browser?

Your Choice?

Ratings for Responsive (0-10)

Ratings for Adaptive (0-10)

Comments

[Back to List](#)

Survey Page: Different between Responsive and Adaptive website

localhost/Survey/Home/Responsive/VSAdaptive

Responsive VS Adaptive Website Survey User Tables Add Feedback Responsive vs Adaptive About

Difference between Responsive and Adaptive

Responsive	Adaptive
Relying on flexible and fluid grids on screen sizes	Adaptive relying on predefined screen sizes
Responsive website use CSS and flexible foundations	Adaptive use streamlined, layered approach
Responsive website it take little longer to load on browser	Requires CSS loading time compare to Responsive Website
In the responsive sites the contents are shuffling in order to fluidly fit the device window so here need to pay particular attention to the visual hierarchy of the design.	But this does not happen in adaptive sites
Responsive sites are works on client side meaning the server provides the contents and the client's browser then rearrange those using media queries.	Adaptive sites may require some special maintenance
Responsive sites are flexible enough to keep working on their own	Adaptive sites are server side meaning the server first detects the clients screen information and then it provides the layout which is best suited for the screen

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Appendix 4

Survey pictures



Appendix 5

Usability evaluation checklist for web sites

This brief checklist is an aid to evaluating a web site for usability. The checklist may be freely used and distributed, provided the copyright information is retained.

Navigation	Compliance			Notes
	Always	Sometimes	Never	
There is a clear indication of the current location	☐	☐	☐	
There is a clearly-identified link to the Home page	☐	☐	☐	
All major parts of the site are accessible from the Home page	☐	☐	☐	
If necessary, a site map is available	☐	☐	☐	
Site structure is simple, with no unnecessary levels	☐	☐	☐	
If necessary, an easy-to-use Search function is available	☐	☐	☐	

Functionality	Compliance			Notes
	Always	Sometimes	Never	
All functionality is clearly labelled	☐	☐	☐	
All necessary functionality is available without leaving the site	☐	☐	☐	
No unnecessary plug-ins are used	☐	☐	☐	

Control	Compliance			Notes
	Always	Sometimes	Never	
The user can cancel all operations	☐	☐	☐	
There is a clear exit point on every page	☐	☐	☐	
Page size is less than 50Kb/page	☐	☐	☐	
All graphic links are also available as text links	☐	☐	☐	
The site supports the user's workflow	☐	☐	☐	
All appropriate browsers are supported	☐	☐	☐	

Language	Compliance			Notes
	Always	Sometimes	Never	
The language used is simple	☐	☐	☐	
Jargon is avoided	☐	☐	☐	

Feedback

	Compliance			Notes
	Always	Sometimes	Never	
It is always clear what is happening on the site	☐	☐	☐	
Users can receive email feedback if necessary	☐	☐	☐	
All feedback is prompt	☐	☐	☐	
Users are informed if a plug-in or browser version is required	☐	☐	☐	
Users can give feedback via email or a feedback form	☐	☐	☐	
If necessary, online help is available	☐	☐	☐	

Consistency

	Compliance			Notes
	Always	Sometimes	Never	
Only one word or term is used to describe any item	☐	☐	☐	
Links match titles of the pages to which they refer	☐	☐	☐	
Standard colours are used for links and visited links	☐	☐	☐	
Terminology is consistent with general web usage	☐	☐	☐	

Error prevention and correction

	Compliance			Notes
	Always	Sometimes	Never	
Errors do not occur unnecessarily	☐	☐	☐	
Error messages are in plain language	☐	☐	☐	
Error messages describe what action is necessary	☐	☐	☐	
Error messages provide a clear exit point	☐	☐	☐	
Error messages provide contact details for assistance	☐	☐	☐	

Visual clarity

	Compliance			Notes
	Always	Sometimes	Never	
The layout is clear	☐	☐	☐	
There is sufficient 'white space'	☐	☐	☐	
All images have ALT text assigned	☐	☐	☐	
Unnecessary animation is avoided	☐	☐	☐	