

Stargazers guide to the Galaxy

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Abstract

Stars have been important throughout history; our ancestors thought they had religious value. Navigators realized they could use the stars for traveling by night, on land or sea. They were also used to create early calendars and helped farmers decide when to plant and harvest their crops (Cain, 2015). They have always impacted life on earth, stars and celestial events can be awe inspiring and exciting to see. They may no longer be used for navigation or to organize harvest, but they are still of importance to the world. They create connections between people and their environment and give us perspective in our lives.

This dissertation describes the work completed to develop a web application that will provide its user information on celestial events. This application will allow users to find relevant celestial events relative to their location. The ultimate goal is that this will provide stargazers with a tool to establish what they may be able to see outside that night.

The application was developed for use online, primary access using a laptop. User requirements were identified with the help of focus groups. These requirements were essential to develop the prototype. The key functions were implemented and tested. Through testing and focus group feedback, recommendations for future development were collated.

Keywords: Stargazing, celestial events, web application

1 Introduction

1.1 Introduction

Interest in space, stars and physics is increasing. The BBC is broadcasting stargazing on television and getting record viewing. There is clear interest in this field and the best way to view stars or celestial events is to get outside and see for yourself (McVeigh, 2013). Stargazing provides benefits to health and education and it is desirable to promote this activity (Cagle, n.d.). Sales records through Amazon show that there is an increase in purchases of telescopes and other stargazing apparatus (McKie, 2012). A stargazer setting up may find it difficult to establish what is viewable out their window or from their own location. Online resources provide plenty of images and information on celestial events but it can be difficult to find personalized information. The user may need to view several websites before finding the information they require. These obstacles could leave the amateur stargazer feeling disillusioned and eventually result in them giving up their new hobby. Mobile applications also provide sources of information for users and can vary in ease of use and function. These applications can provide users with an accurate way to identify stars and constellations. Some applications make use of device features to create augmented reality to provide the user with clear direction for constellations and planets. These resources provide support for beginners and even seasoned stargazers. At present there are more celestial images available online than ever before, however this does not satisfy the demand, because stargazers still go out in the cold at night to view these sights with their own eyes (Jha, 2014).

Through the research conducted it is clear that the available websites and applications available do not provide an effective celestial database. There is a lot of information spread out over different platforms but not one source to access all of them. This type of resource will provide a suitable way for users to search for celestial events that users could view from their location.

1.2 Problem Statement

It is clear that there is an increasing interest in stargazing as a hobby. However, there is no comprehensive resource that provides the amateur or experienced stargazer with information on the celestial events they can view in their location.

The solution is a restful API that provides the ability for users to search for celestial events in their location to assist them in their night time viewing. It will also allow registered users to add events or share knowledge with other members

1.3 Aim

To develop a web application that can collate data regarding celestial events that is spread out over the internet and provide it for users to access. This will allow users to search for celestial events that can be viewed in their location.

1.4 Objectives

In order to successfully achieve the aim defined above, a set of objectives were agreed.

Review applications and websites currently available to Stargazing enthusiasts. Assess the strengths and weaknesses of these applications

Create a questionnaire to be completed by focus group

Agree on a set of functional and non-functional requirements based upon feedback from focus group

Design the application structures to incorporate the functional and non-functional requirements.

Implement the design and test with focus group to ensure usability.

1.5 Requirements for Development

The development of this application will require the use of multiple programming languages, software and hardware. This will ensure the aims set out are achieved.

The software to be used are listed below

NotePad++

PHP, JQuery, JavaScript, HTML and CSS

Abyss Webserver and MySQL

The hardware required for developing

Asus Laptop

External Hard drive

1.6 Dissertation Outline

Chapter 2: The Analysis

This chapter provides an account of the investigation of the problem and research on resources available currently. The review of four existing resources are discussed. The strengths and weaknesses are identified and presented in table format outlining pros and cons.

Chapter 3: The Requirements

This chapter identifies requirements to the end-user. These have been established through research of the problem and analysis of other applications on the market. The findings from the Focus group were also included to identify end-user requirements.

Chapter 4: The Design

This chapter presents an overview of the application design and discusses the design methodology followed. It also shows the proposed database and the site map of the website application. This chapter will also describe the user interface, layout and colour scheme.

Chapter 5: The Implementation

This shows implementation of the design and the stages of development. It outlines the programming languages and software utilized to create the first working version of this concept.

Chapter 6: The Testing and Evaluation

This shows the type of testing completed by the developer and focus group, it also analyses the results of testing from the focus group.

Chapter 7: The Conclusion

This summarises the work completed and critically assesses the results. The chapter will review the development of the project and put forward recommendations for further development.

2 Analysis Review

2.1 Introduction

This chapter will provide analysis of the problem and research completed. It will also discuss the benefits of stargazing on an individual level and also at global level. This chapter will include research completed on other applications already in the market. It will present the strengths and weaknesses found in table format. This will be followed with a summary.

2.2 The Literary review

In 1969 when the first man walked on the moon, over 5 million people worldwide watched this on their television. This sparked a huge interest in space exploration and stargazing. Parents bought their children astronaut outfits and telescopes. In the years since this great fete, interest has faded. It is only recently that astronauts and Scientist have hit the headlines and brought back a keen interest in stargazing and Space exploration. Brian Cox, a former rock star, now turned scientist has paired up alongside Dara O'Brien to host STARGAZING LIVE on the BBC. This program has been running since January 2011. This show has been creating huge interest in the night skies and physics. His show stargazing live brought in millions of viewers since it started a few years ago and online shopping sites are recording huge increases in sales of Telescopes. Some sites recording increases of 500% in sales and have named the surge in interest the COX effect (McKie, 2012). This interest has increased further due to Canadian Astronaut Chris Hadfield. During Chris Hadfield's last stint on the International space station, he uploaded videos online about his time in space. These videos were viewed by millions worldwide, it now looks like Space exploration and astronauts are back on the conscience of most people. Even more recently a UK astronaut Tim Peake has hit the headlines, he is the first Briton to serve on the international space station. This has created a huge surge in interest and is putting focus on space exploration. This is encouraging for young people; they can again dream of becoming an astronaut. It has generated interest in schools and universities across the UK, students want to learn about the stars and planets above their heads.

2.2.1 Benefits to the individual

The activity stargazing provides a lot of benefits to the individual, and also the community. On an individual level this activity provides an incentive to go outside and although it is a relatively low energy activity it is getting people up from the sofa and watching TV. It also encourages people to work together, stargazers can share individual knowledge pointing out constellations, planets etc. Stargazing has begun to rival more traditional evening activities with some prime nighttime locations creating stargazing tourism (Glusac, 2010). In some rural locations people are opting to go out stargazing instead of a romantic meal or a social drink. Learning about the night sky can also help educate, for children it creates an interactive way to learn how to count, understand

shapes and patterns. It can be a lot more fun for kids to learn in this manner. Life has become more reliant on technology, people are spending more time on computers and tablets. It is most noticeable in children; the childhood many parents had is completely foreign to what childhood looks like today. Recent studies have shown that the time children spend playing outside now only amounts to 50% of the time their parents did during their childhood. A survey completed by the National Trust shows that the majority of parents believe it is important for their child's development to play outside (The Guardian, 2016). It can be difficult to get children outside away from their computers and TV. Stargazing is a great activity to encourage children outside and get them connecting with their environment. Looking into space, learning about stars and planets can also bring up a lot of questions. Where do we come from? How did we get here? How far away are the stars? These are all good questions whether you are young or old. When learning about stars and planets, we realize that we are all part of something much bigger. There have been studies conducted that show people who stargaze can be more generous. The study showed that participants were inclined to focus more on the greater good of people as a whole rather than their own individual gains. This was recorded in a Californian study, the study asked people to look at images from nature that would create a feeling of awe. The study then tested the subject in different scenarios, the results showed that the subject who had the feeling of awe acted more positively in favor of others (Freeman, 2015). Being active and venturing out in the night time air can also benefit your mental and physical health, psychological research has shown this activity can improve your mood, memory and mental health (Handel, 2009).

2.2.2 Benefits to the community

Stargazing has also shown that it can benefit your society and environment. Some quiet countryside locations have begun to take advantage of their dark skies by promoting stargazing tourism. Being located in the middle of nowhere was once a weakness in terms of tourism, for stargazing tourism is now their biggest strength. These quiet locations can provide clear dark skies with minimal light pollution. A Stargazing guru in Scotland has even started offering personal stargazing lessons. This provides a great location alongside an enthusiastic and knowledgeable guide (Rushby, 2013). Any enthusiast will jump at the chance to gain any extra knowledge. Scotland have begun advertising their Dark Sky Town Moffat in Dumfries & Galloway, on their tourism website visitscotland.com. This is the first town in Europe to be awarded this title. This star tourism has been replicated in parts of Ireland and further afield. It has been dubbed "Astro-tourism" by astronomer Bill Dent who has worked in Chile for 6 years and now offers night-time tours to these Astro-tourists (Dixon, 2015). This new interest will be a welcome boost to the economy for rural locations with perhaps previous little investment.

Stargazing will also benefit the environment, the university of Leicester hosted a stargazing live show for a weekend and as a result saved 4% in its electricity bill (University of Leicester, 2013). This was because the university made an extra effort to switch lights off on its campus over the weekend to help with stargazing. This saving was

for one weekend, if all universities followed it would amount to a massive savings for the university and a huge reduction in energy consumption. It could also provide safe locations for people living in urban areas to stargaze.

Stargazing also promotes a connection with nature and the world around us. This connection is important, as people become more connected wirelessly there is a disconnect with their actual surroundings. Stargazing can provide a reminder that we are on this planet together and need to protect it. This realization can promote selfless actions and encourage doing more to lessen our impact on the environment (Freeman, 2015).

2.3 Analysis of applications on the Market

In the market currently, there are many websites and applications available to assist star gazing. These, however fall short of providing a full data base of events but provide other valid service to support star gazing. Reviews of these websites and applications, which have been evaluated for their strengths and weaknesses, can be seen below. Each website or application has been reviewed and the developer has created a pros and cons table for each service. These reviews will culminate in a table looking at all application side by side.

2.3.1 BBC Star Gazing Website

This site provides tutorials, videos and quizzes on all manner of space topics. It provides in depth information on stargazing. This website can be a useful resource for inexperienced and seasoned star gazers. The website itself is in connection with the BBC's program starring Brian Cox and Dara O'Brien. The site also offers download packs for learning about space and fun games to get young people interested in the topic. It supplies a lot of images and videos of specific space events and links to other websites of interest.

TWO Stargazing Live

Home Episodes Clips Galleries Pulsar Hunters Interactive Guides @BBCStargazing

On iPlayer
This programme is not currently available on BBC iPlayer

On TV
There are no upcoming broadcasts of this programme
Last on Episode 4 - The Spacewalk
Series 6
FRI 17 JUN 2016 03:45
BBC TWO
[All previous episodes](#)

Buy online
Where to buy
Available on:
Video download
From suppliers:
BBC Store

Professor Brian Cox and Dara O'Brien are at Jodrell Bank Observatory, joined by special guests to bring you the latest news and the best views of the night sky.

You discovered a pulsar!
Citizen scientists made over 3 million classifications in just two days of pulsar hunting

See the International Space Station
Find out when you can spot the ISS – Tim's on board!

- Spot the ISS from where you live (spotthestation.nasa.gov)
- Live globe showing location of ISS (BBC News)
- Live map showing location of the ISS (www.esa.int)

As it happened: Tim's first spacewalk

Figure 2.1 BBC Stargazing Live website <http://www.bbc.co.uk/programmes/b019h4g8>

Website Pros	Website Cons
Appealing Layout and Design	No Database of upcoming celestial events
Great Use of graphics and Images	No guide or pack to help people view celestial events
Quizzes available on the space and planets	No option to search celestial events by user location
Activity packs available for free download	
Galleries of Images taken	

Table 2.1 Pros and Cons table of BBC STARGAZING website

2.3.2 Dark Sky Discovery website

This site is aimed at stargazers in the UK and provides information on seasonal sky lines and what you can see in different seasons. This website does not offer an event calendar or any information on other night sky events. The website provides sky charts that can be downloaded and information on locations throughout the UK that they recommend to go for star gazing.

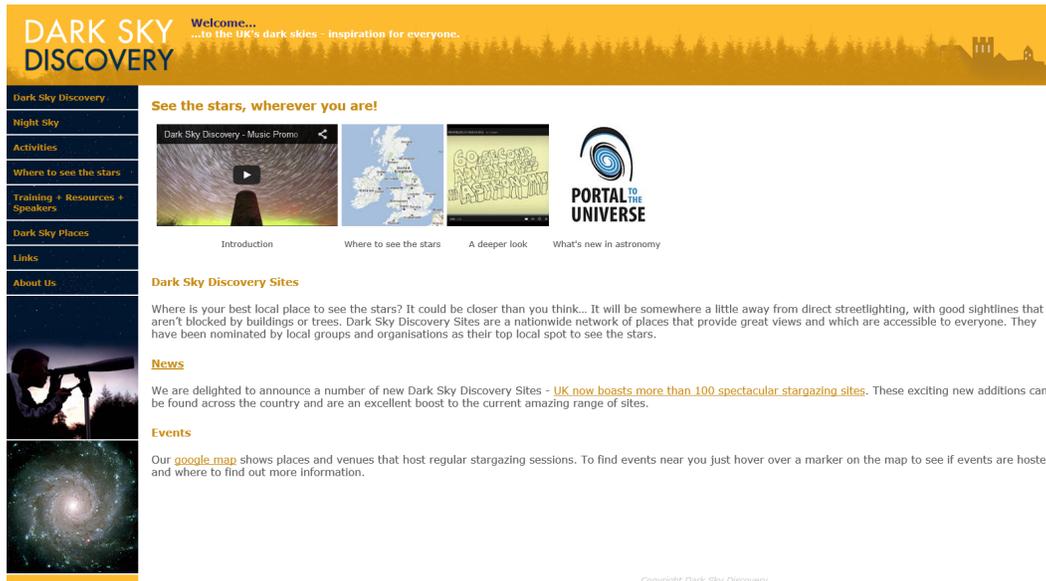


Figure 2.2 Dark Sky Discovery <http://www.darkskydiscovery.org.uk/>

Website Pros	Website Cons
Easy to navigate the website	No Database of upcoming celestial events
Star Charts available to print	No images or videos on support for star gazing
Provides options to join groups in your area	No option to search celestial events by user location
Provides recommended locations for night time viewing	Doesn't provide a facility to upload images and share with fellow enthusiasts
Links to training and resources	

Table 2.2 Pros and Cons table for DARK SKY DISCOVERY website

2.3.3 Nasa Spot the Station

This is available on the NASA website and it is a straight forward search engine to see when the International Space Station can be viewed in the skies above. This is a great service it allows the user to input their location and then it returns a list of when the space station is viewable. It returns times date and where in the sky it will appear and disappear. It also offers the user the option to share this with other via social media sites. The site also gives the users tips on how to view the station what it looks like and ways to calculate the correct spot in the sky to look.

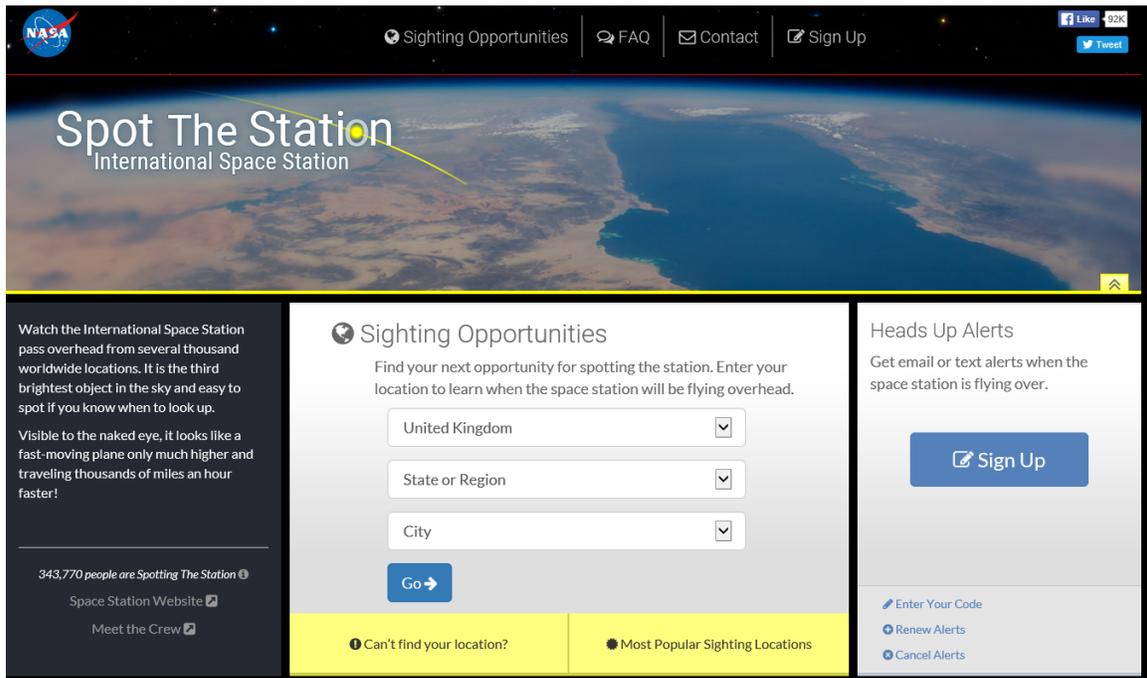


Figure 2.3 Spot the station <https://spotthestation.nasa.gov/>

Website Pros	Website Cons
Allows user to input location and receive information specific to location	No Database of upcoming celestial events
Allows user to share results on social media	Information on how to view isn't user friendly
Provides Instructions on how to view the space station	No gallery of images showing space station

Results displayed in timetable fashion	It only provides info for viewing the space station
Allows user to sign up for alerts	No other information provided about the space station

Table 2.3 Pros and Cons table for SPOT THE STATION NASA website

2.3.4 Stargazing for Beginners National Trust website

This site provides very limited information and is aimed primarily at getting people started with stargazing. This website does not offer any events calendar, but does provide an option to download the constellations that you can look for this season. This download provides guides on how and what to look for. This guide would benefit from images to support the user. A video is provided which describes the constellation Orion, this is informative and definitely peaks your interest in constellations. The video makes no attempt at showing you how to view this constellation or where to look in the night sky. The site provides a starting off point as the information is limited. The information that is available is very interesting however the user will need to do a lot of the searching themselves for more answers elsewhere.

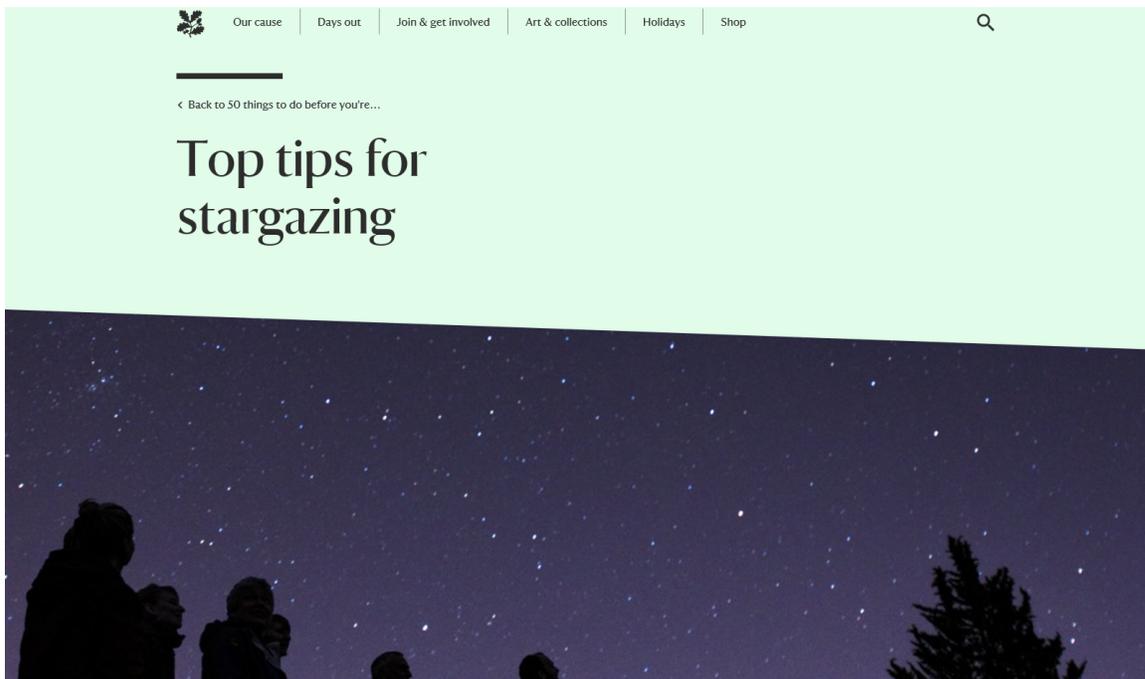


Figure 2.4 National Trust Website

<https://www.nationaltrust.org.uk/features/stargazing-for-beginners>

Website Pros	Website Cons
Website uses appealing layout and design	No Database of upcoming celestial events
Offers information in easy to understand format	Information on constellations is limited
Provides videos on star constellations	No gallery of images
Results displayed in timetable fashion	Does not offer facility to share images taken
Provides general advice and tips on night time star viewing	

Table 2.4 Pros and Cons table for NATIONAL TRUST website

2.3.5 Analysis of website reviews

The reviews show that applications currently available provide some strong features. The analysis also made it clear there are areas to improve and features that could be improved or added. The reviews have been combined into two tables combining the functional and non-functional features. The functional features are marked over six headings with a maximum of three marks for each category. This means the maximum mark for this review is Eighteen. The non-functional features are marked over five headings with a maximum mark of Fifteen. The reviews were completed by the developer; it was shown that the BBC Stargazing website received the best rating over both tables.

Website Functionality	User Interface	Localized Information	Quality of Images	Ease of Use	Info on how to view	Useful links	Marks /18
BBC Stargazing	√ √ √		√ √ √	√ √ √	√	√ √ √	13
Dark Sky Discovery	√ √	√	√	√ √	√	√	8
Nasa Spot the Station	√ √	√ √	√	√ √		√ √	9

Stargazing for beginners National Trust	√ √		√	√ √		√ √ √	8
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Table 2.5 Review of website functionality

Website non-function	Portability	Reliability	Efficiency	Ethical	Accessibility	Marks /15
BBC Stargazing	√ √ √	√ √ √	√ √ √	√ √ √	√ √ √	15
Dark Sky Discovery	√ √ √	√ √	√ √	√ √	√ √	11
Nasa Spot the Station	√ √ √	√ √ √	√ √ √	√ √ √	√ √ √	15
Stargazing for beginners National Trust	√ √ √	√ √ √	√ √	√ √ √	√ √	13

Table 2.6 Review of websites non-functionality

2.4 Summary

This chapter shows the literature and resources reviewed on stargazing by the author. The popularity and interest in stargazing is shown, as well as benefits to the user and environment. The existing applications on the market are discussed and pros and cons shown. This information and research gathered is integral to the development and design of the system to assist the stargazer in their night time viewing.

3 Requirements

3.1 Introduction

The chapter identifies the needs and requirements for the user. The functional and non-functional requirements were established with the use of a focus group. The focus group provided feedback through questionnaires and discussions. The feedback given is reviewed and analyzed. This is combined with the research and market analysis completed by the author. This feedback is presented alongside user stories with the finalized key functional and non-functional requirements.

3.2 Requirements

Through the research completed it became clear that a web application would be best suited for this project. The aim is to allow users to gain access to the stars from their individual location. The application is to allow users to access the data relevant to their location. This would indicate that users may use their static computer/laptop or mobile devices to access the data. In order to accommodate this access a web application was considered. The developer felt this format would be better suited to handle the images and information required than a mobile application. This would also allow for cross-platform access and can be made available free of charge. The user would be able to gain access to this web application over a range of platforms. This will allow for maximum access and open up the night skies to a bigger audience. The user will want to access data sets held over the internet and get back the information relevant to their query.

3.2.1 Feedback from Questionnaires

A questionnaire was developed which was sent out to a range of stargazer enthusiasts ranging from novice to expert, participants also varied in age and gender. The questionnaire was created in three sections, each asking three questions.

The first section was designed to identify the knowledge level of the user, and establish how much time they spend stargazing. This section also established whether they felt this web application would be useful to them.

The second section looked to identify the preferred content and structure. This allowed the focus group to put down what they wanted in terms of functionality.

The third section provided the focus group with an opportunity to comment on how they wanted the application to look and feel. This focused on the colour scheme and font type. This section also allowed participants to volunteer for testing the application.

The questionnaire was designed and created in a way to return the optimum amount of information, without being perceived as too in depth. The questionnaire was distributed to individuals with an interest in stargazing ranging from amateurs to professionals.

There were 12 participants invited to take part in the questionnaire, 10 questionnaires were returned fully completed. Of the completed questionnaires 50% of participants agreed to take part in testing.

3.2.2 Analysis of feedback

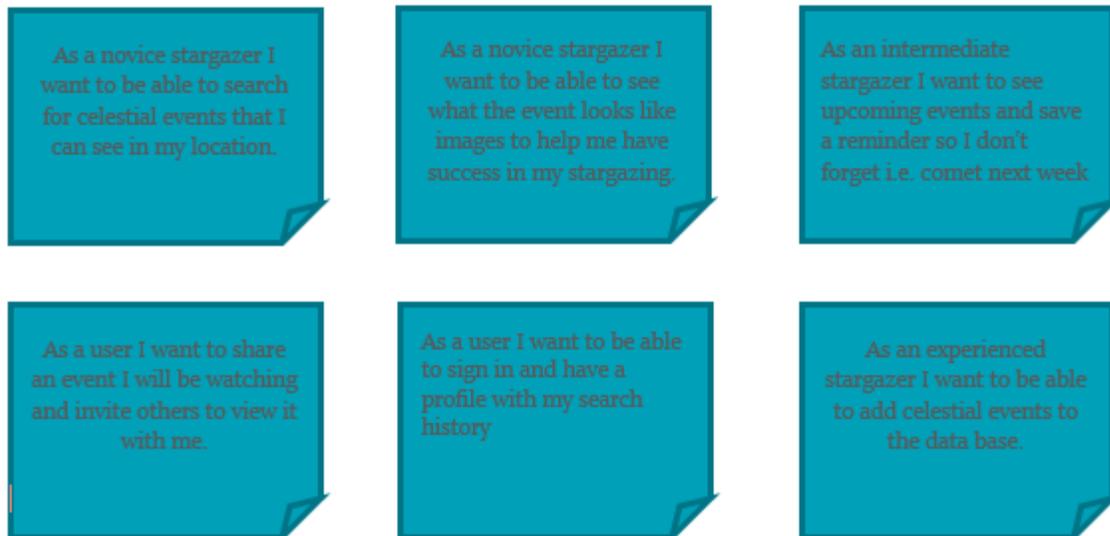
Question	Answers
1	60% of participants had some experience and could spot some constellations 20% felt they could spot all constellations 20% declared as novice
2	100% of participants agreed a database of celestial events would be beneficial
3	Most of the participants were aware of online resource but only 50% would actually recommend them to a friend
4	The following functions stood out from the focus group feedback <ul style="list-style-type: none"> • Database of celestial events • Images of events for reference • Tips on how to view • Share function to share results with friends
5	The following functions stood out from the focus group feedback <ul style="list-style-type: none"> • Login function • Ability to save event to a personalized calendar • Option to add knowledge to database and share with others
6	This was the proposed structure chosen by the majority of participants <pre> graph TD Home[Home] --> DB[Data Base Celestial Events] Home --> Calendar[Calendar] Home --> Images[Images] DB --> Search[Search Events] DB --> Add[Add/amend Events] Search --> ViewResults[View Results] ViewResults --> Share[Share Event] ViewResults --> ImagesEvent[Images of Event] ViewResults --> Tips[Tips for viewing] Calendar --> Amend[Amend calendar] Calendar --> ViewCalendar[View calendar] Images --> AddImages[Add Images] Images --> ViewImages[View Images] ViewImages --> SearchImages[Search Images] </pre>

7	The majority of participants were happy with the San-Serif font type
8	There was no clear majority for this question so more research will be done on deciding the colour scheme
9	50% of returned questionnaires agreed to take part in testing

Figure 3.1 questionnaire feedback analysis

3.2.3 User Stories Developed from feedback

The feedback from the focus group questionnaires were analyzed, reviewed and is represented in the format of user stories. These user stories will be used to create functional requirements for the application.



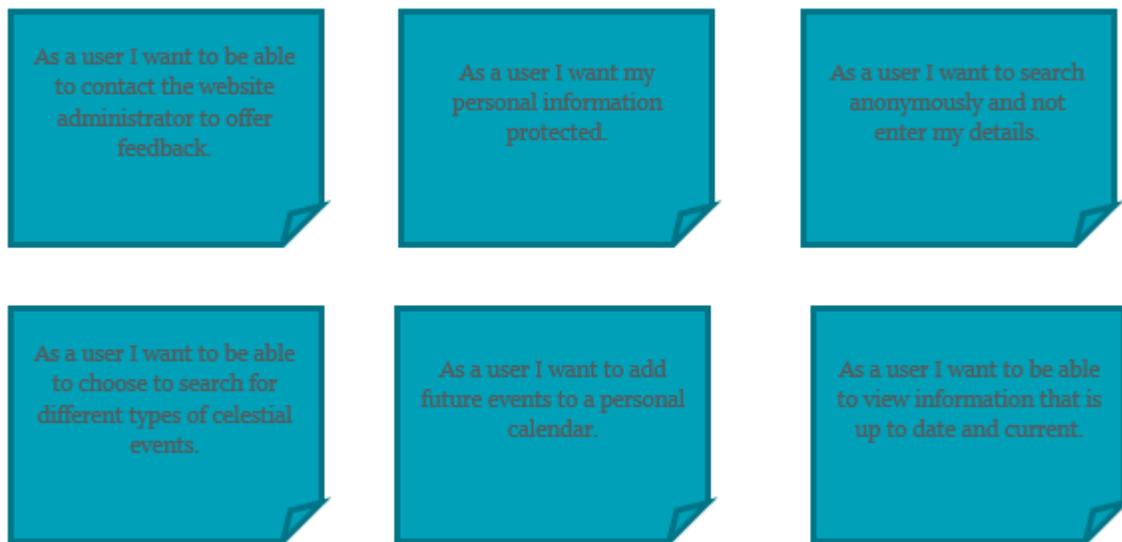


Figure 3.2 User Stories

3.2.4 Functional Requirements

The functional requirements of the system describe the actual activities and operations that it should be able to perform. I have considered the following

- This web application should allow users to request data
- The web application should allow users to find data relevant to their location
- There should be a facility to share search results with others
- There User should be able to log in as a member
- There should be a facility to contact the website designer
- The user should be able to view images on events
- Users should be able to share knowledge and add events to a public forum

3.2.5 Non-Functional Requirements

The Non Functional requirements differ from the functional requirements. The Non Functional requirements simple describe the way the functions should perform. I have considered the following.

- Usability: The web application must be well thought out and designed so that it can be accessed across different browsers and platforms. The site must also be

intuitive for the user. It must provide the facilities in an easy to use manner that are easy to understand.

- **Efficient:** The site website must be efficient and not use excessive time when retrieving data or when changing pages. I will ensure to follow SQL programming practices to keep my website efficient
- **Accessibility:** This website should be open to all users without any obstruction or inequality
- **Reliability:** Using good architectural design will minimize unexpected behavior and prevent errors
- **Portability:** The website must run and behave as expected on a number of devices and platforms

3.3 Summary

This chapter has shown the analysis of feedback from the focus group. This analysis resulted in a set of user requirements. The feedback received was used to create user stories, they were then broken down into functional and non-functional requirements. These requirements have been created in response to the comments of the focus group. These will be used when creating a design for this project.

4 Design

4.1 Introduction

This chapter shows an overview of the design chosen for this application. It will discuss the design methodology and user interface. It will also cover the proposed navigation of the application and architecture. There will be a brief discussion over the client/server

relationship and also the proposed languages to be used for this application. The database will also be discussed.

4.2 Website Guidelines

It must be considered that this web application will be accessed through different platforms, each platform will have different capabilities and may impact the usability of my web application. The developer must ensure that regardless of the platform that the content can still be accessed. During development of this web application guidance has been sought to ensure that the application is open and accessible to all. W3 has provided four principles that should ensure the web content is accessible by everyone. They are provided below;

Perceivable

- Information and user interface components must be presentable to users in ways they can perceive
- This means that users must be able to perceive the information being presented

Operable

- User interface components and navigation must be operable
- This means that users must be able to operate the interface

Understandable

- Information and the operations of the user interface must be understandable
- This means that users must be able to understand the information as well as the operation of the user interface

Robust

- Content must be robust enough that it can be interpreted reliably by a wide variety of user agents
- This means that users must be able to access the content as technologies advance (W3C, 2016)

These principles will be followed as closely as possible to ensure that all people can access the web application.

When designing this web application Shneiderman's Eight golden rules were applied. These rules were created in 1987 from research done by Ben Shneiderman, they still apply for most interactive systems today. These rules, some may be more obvious than others

but these rules apply to the design of most software and hardware on the market today (Wong, 2016). The eight rules to ensure optimum interfaces are as follows;

Consistency

- Use familiar icons, colours and layouts.
- This will help users become familiar with the landscape of your project

Enable Shortcuts

- Provide shortcuts that users can action as they become more experienced

Offer Feedback

- Provide feedback for every action, feedback should be readable and easy to understand

Design Dialog

- When an action is completed user should be notified so they have confidence in their action

Simple Error Handling

- Design systems to be fool proof but offer step by step instructions when error occurs

Permit easy reversal

- System should be obvious to user and easy to reverse

Support internal locus of control

- Allow users to be the initiators of actions and a sense they are in full control

Reduce short-term memory load

- Interfaces should be as simple as possible
- Choose recognize over recall (Block, 2013)

You will see these rules in action today if you examine an Apple, Samsung or Microsoft product. Some may be more obvious than others but you see these rules being applied to most software and hardware on the market today. The Developer will continue with this trend and look to incorporate these rules in the project design.

4.3 User Interface Design

UI is important because it can make the difference between a hugely successful website and a failed one. Clear navigation is crucial to ensuring the user has a positive experience and will return to the site. The goal is to allow the users to navigate without thinking, the user can navigate intuitively and complete their task. It is beneficial to aim for simple design, users are not using this service to enjoy the design so it is important to display the content clearly and use white space effectively (Friedman, 2008). This approach was used when creating mockups and digital story boarding. This allowed for an intuitive simple consistent design to be implemented.

4.3.1 Story Board

Storyboards were also useful in gaining an understanding of how the functional requirements will be implemented within the website. This ensured every page of the site could be envisaged before coding. This ensured a well thought out design is created and built from the user's perspective.

As illustrated in fig 4.1 and fig 4.2 the story board shows how the user will complete tasks and progress through the website. The full proposed storyboards will be included in the appendices.

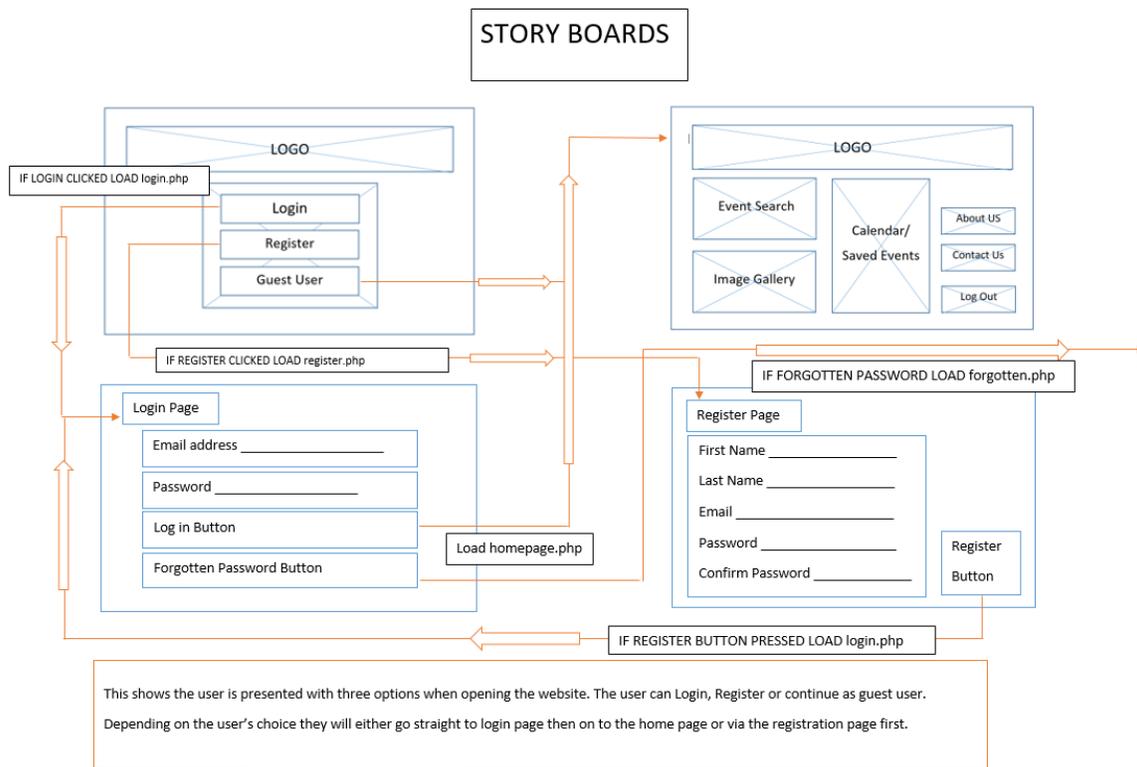
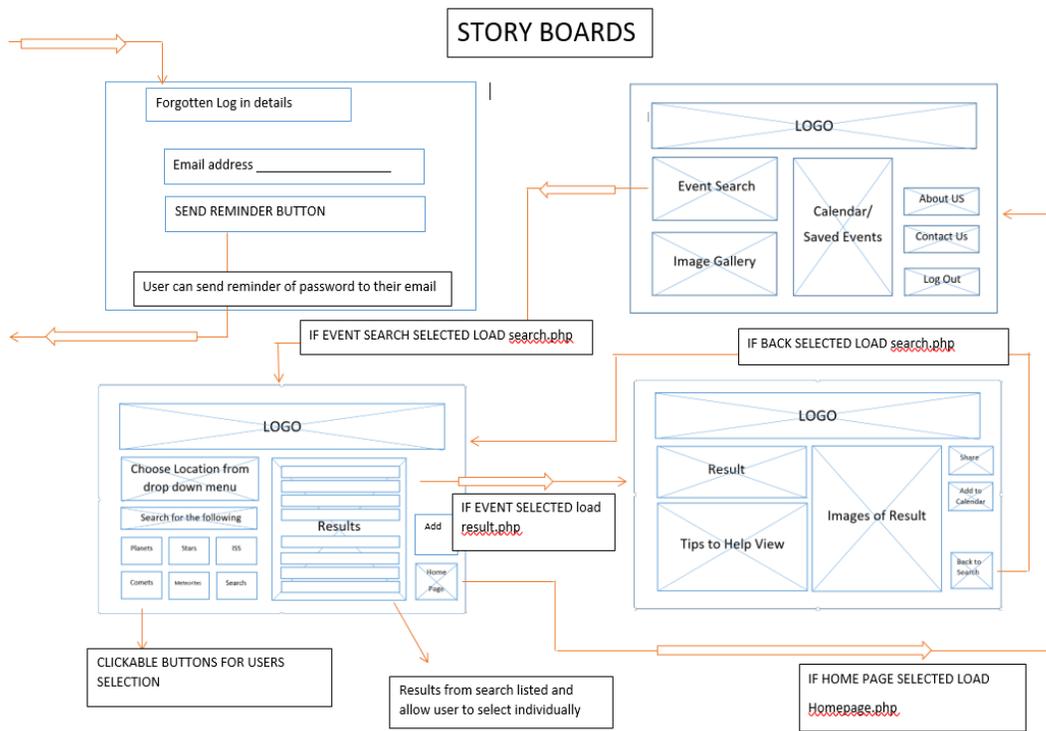


Figure 4.1 & 4.2 Story Board Showing user interaction with greeting screen



4.3.2 Colours and page layout

The use of colour is important within the user interface and can also help by improving navigation of the site. Colour can be used to attract the attention of the user. There is an opportunity to use colour to help build a site that will feel more intuitive to the user (Fadeyev, 2008). Colour is a powerful aspect of design and can also be used to bring out different emotions in the user. Using warm colours can energize the user and increase alertness, while cool shades tend to be more tranquil and relax the user (Cao, 2015). These concepts will be used to help in creating example colour schemes. These were included in the mock ups that were shared with the focus group.

The focus group were given a selection of mock ups using potential colour schemes, these selections are presented in figure 4.3.

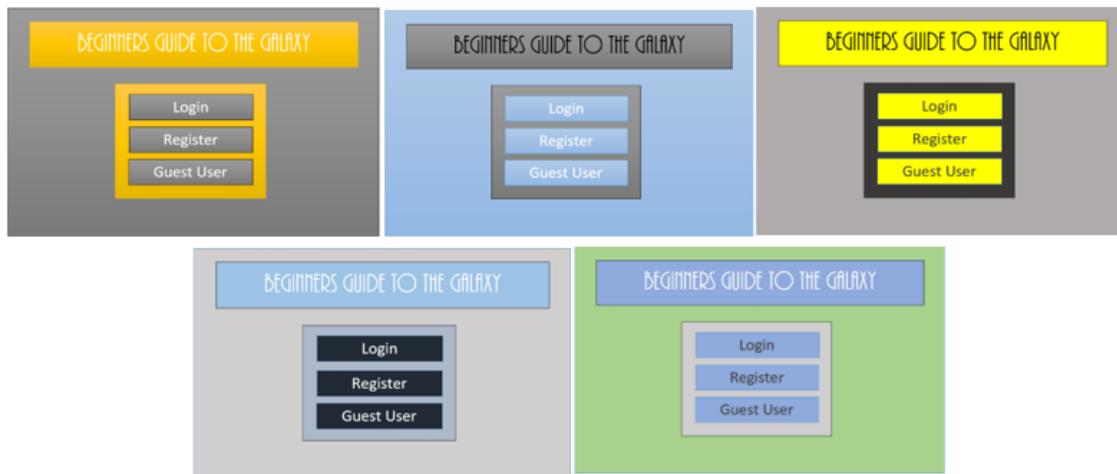


Figure 4.3 Colour Schemes presented to focus group

Using feedback from the focus group it was decided to use a mixture of warm and cold colours. This scheme will promote a peaceful energy that the user can take into their night time viewing. The final colour scheme is shown below in fig 4.4



Figure 4.4 colour scheme



4.3.3 Font

When designing and creating websites, font is important for several reasons and must be considered when deciding on the final choice (Cousins, 2015). It is important that the text is readable and makes good use of space. It is also important to consider font that will generate quickly on the page as users care more about time than a nice font that loads slowly. Using a great font is essential to great design, but picking fonts can be difficult (Pack, 2015). Combining feedback from the focus group and research, two fonts were selected and paired up. The two fonts chosen were Josefin slab and Playfair display, they are shown below in figure 4.5. These fonts will provide clear easy to read text.



Figure 4.5 Font Type Josefin Slab and Playfair Display

4.4 Architecture Design

The website application was created using several different systems and software working together to provide the functionality of the final application. The following sections detail each system used and its importance.

4.4.1 Client/Server Relationship

The Client/ Server Relationship is what allows the user to input requests to their web browser and get the website they requested. The client side sends requests to the server side, the server side then returns the response to the client side.

Examples of a client are your laptop or mobile device being used to access a website, this is actually requesting information from the server. The client cannot access the website without the server (BBC, 2016). The relationship between the client and server is displayed below in figure 4.6

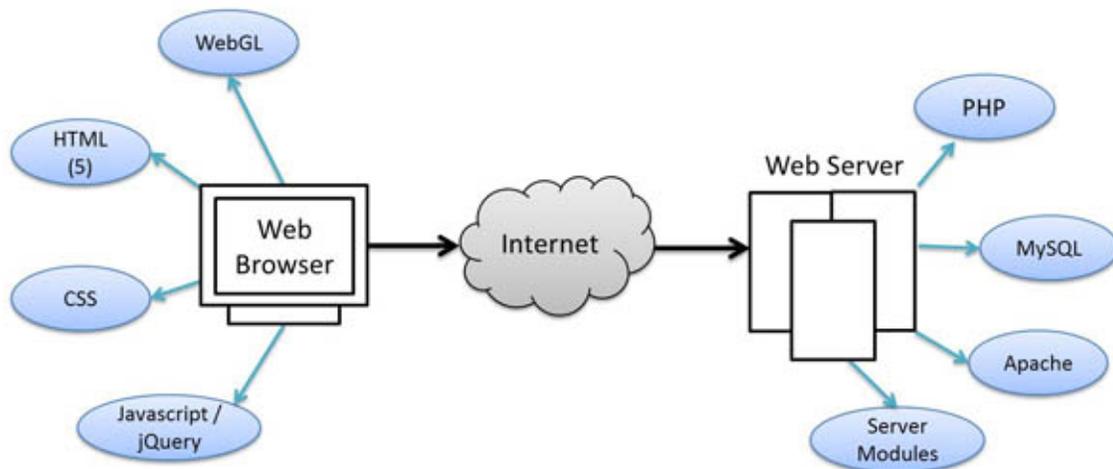


Figure 4.6 Client/ Server Relationship

4.4.2 PHP and MySQL

The project will be developed using PHP, this is a server scripting language especially suited for web development and can be embedded into HTML (McGrath, 2012). The code is written using notepad++, PHP can allow developers to create more than in HTML alone. The PHP engine will connect to MySQL database before sending responses back to the web server. In fig.4.7 below it shows a connection made between the PHP engine and the MySQL database.

```
1  <?php
2
3  require ('../connect_db.php') ;
4
5  $q = 'SHOW TABLES' ;
6
7  $r = mysqli_query( $dbc , $q ) ;
8
9  if ( $r )
10 {echo '<h1>Result Set Returned OK</h1>';}
11
12 else
13 {echo '<p>'.mysqli_error($dbc). '</p>';}
14
15 mysqli_close ( $dbc );
```

Figure 4.7 PHP Connection with MySQL database

MySQL will be used to manage stored data and as with PHP is a server-sided software. The database will take queries from the PHP engine and send data back. This works well alongside PHP. It will provide back-end storage for the website. The project will require a structured database to hold relevant data for celestial events. This data will be drawn down using Nasa data sets with relevant connections. Illustrated below in fig.4.8, shows database tables created using MySQL. This particular table is holding all the data required for the users. This will hold data of members who have registered.

```
mysql> EXPLAIN users ;
```

Field	Type	Null	Key	Default	Extra
user_id	int(10) unsigned	NO	PRI	NULL	auto_increment
first_name	varchar(20)	NO		NULL	
last_name	varchar(40)	NO		NULL	
email	varchar(60)	NO	UNI	NULL	
pass	char(40)	NO		NULL	
reg_date	datetime	NO		NULL	

6 rows in set (0.05 sec)

Figure 4.8 database table of Users

4.4.3 Abyss Web Server

The project will be hosted using Abyss Web Server. Abyss provides a free compact web server that can run on Windows, Mac and Linux operating systems. It is well suited to companion PHP and MySQL which will also be used in this project. The web server will connect to the user via HTTP request and response. It will connect with the PHP engine using PHP requests and get HTML responses back.

4.4.4 HTML and CSS design

HTML or Hypertext Markup Language is the code that describes web pages, this allows the developer to write down the words they want to appear on the web page. The developer can add tags or elements to the words to enable the browser to understand what is a heading, where a paragraphs begins and so on (Duckett, 2011). This is the code to create the structure and contents of the web page.

CSS or Cascading Style Sheets is the language to control the style and layout of the webpage. This language will be used by the developer to style the webpages, this controls things like the colour of the text and font types. This will allow the developer to add background images if required and control the positioning of the different elements on the screen (Duckett, 2011).

The use of both HTML and CSS will allow the developer to add content and style to the web pages, this will ensure the user can access the content but also find the web page intuitive and appealing.

4.4.5 Java Script and JQuery

Java Script is a cross platform language that can be used to make web pages more interactive, it can modify content used in a web page while it is being viewed in the

browser. It allows the web page to respond to what the user is doing and react to events. JQuery doesn't do anything that Java Script cannot do, but it does offers the developer a simple way to achieve many Java Script task quickly and consistently. JQuery enables the developer to achieve the same goals but by using less code (Duckett, 2011).

4.4.6 Database Design

A relational database was constructed for this project; this will allow the data to be arranged into set tables. This will enable the data to be accessed or reassembled without having to reorganize the database tables.

The first step in designing the database was to decide what data would be stored, through research of the functional requirements the data required was agreed upon. These are displayed below;

- User data to allow for login features
- Event data to allow users to search and find out about celestial events
- Forum data to allow users to add knowledge and share with other members

This data was simplified down into the relevant entities and relationships needed. There was particular focus put on the event data to ensure it was stored so that it could handle search requests from users. This was problematic as each celestial event may be viewable over a large area i.e. several cities and over several days or even months. The developer spent some time ensuring this aspect was developed robustly. This extra time was spent to ensure that the database is designed so that it would be scalable for future expansion. The developer used normalization to ensure the database did not contain any many-to-many relationships and The database is displayed in Figure 4.9 as an Entity Relationship Diagram.

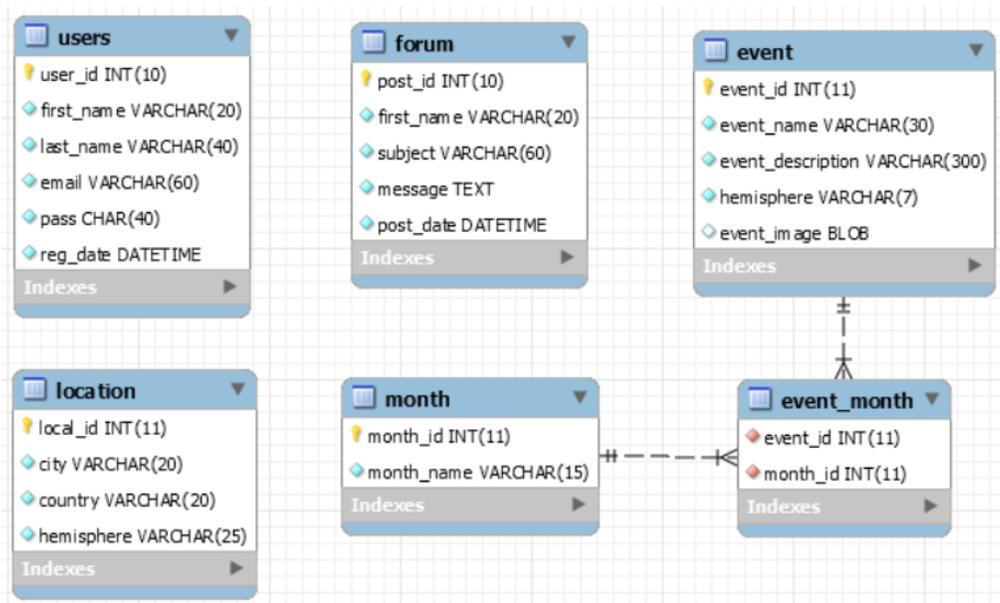


Figure 4.9 Entity Relationship Diagram of Database

This Entity Relationship diagram shows the six tables used and their entities it can also be represented in standard shorthand

- Users (user_id, first_name, last_name, email, pass, reg_date)
- Forum (post_id, first_name, subject, message, post_date)
- Event (event_id, event_name, event_description, hemisphere, event_image)
- Location (local_id, city, country, hemisphere)
- Month (month_id, month_name)
- Event_Month (event_id*, month_id*)

The database can now handle a user request for events viewable from a specific location and month. The developer decided to include the hemisphere field, this will enable further expansion to hold data for northern and southern hemisphere data so that this project could be rolled out worldwide.

4.5 Summary

This chapter has outlined the design choices taken for the proposed website 'Stargazers guide to the Galaxy'. It has discussed the User interface design, Database design and the languages and systems required for the project.

5 Implementation

5.1 Introduction

This chapter describes the approach completed to develop the stargazer guide to the galaxy application. It will discuss development and issues encountered by the developer while building the initial prototype. It will also discuss key functions of the application and the systems used to implement them. The connections made between database and website will also be discussed.

5.2 Implementation Environment

The web application was developed using the following: PHP, MySQL, HTML, CSS, JavaScript and JQuery. These languages were all foreign to the developer at the beginning of this project and needed to be self-taught before implementation could begin.

The implementation was completed using the following:

- MySQL, to manage the database
- Notepad++, to develop the PHP, HTML and CSS files
- Abyss Webserver X1, this allowed web application production using PHP

These systems were readily available at no cost online, they were downloaded and used on

- ASUS X555LAB laptop, intel core i5-200U 2.20GHz 8Gb RAM and 64-bit Windows 10

The testing of the application was carried out on the same machine.

5.3 Implementation process

The developer used the agile methodology for this project, this approach allowed the developer to break tasks down into small stages. This allowed the developer to move between stages of the project as needed. When a certain stage was found to be challenging timescales could be amended. This style also enabled the developer to relay with supervisors regularly and apply any necessary changes from feedback.

5.3.1 Database Structure

The proposed database created and discussed in the previous chapter was found to be suitable during implementation. There was no amendment needed to the original design. Implementation began with the creation of each table needed for the database. The developer used MySQL for constructing the database, each table added with the relevant constraints needed to ensure they could handle query's.

As the database structure was designed in advance and additional time spent to ensure it was robust, this implementation was completed without unexpected errors or delays. The developer followed MySQL commands to create tables, creation shown below in Figure 5.1

```
CREATE TABLE IF NOT EXISTS users (
    user_id INT UNSIGNED NOT NULL AUTO_INCREMENT,
    first_name VARCHAR(20) NOT NULL ,
    last_name VARCHAR(40) NOT NULL ,
    email VARCHAR(60) NOT NULL ,
    pass CHAR(40) NOT NULL ,
    reg_date DATETIME NOT NULL ,
    PRIMARY KEY (user_id) ,
    UNIQUE (email)) ;
```

Figure 5.1 Create Table SQL code

This format of table creation was used until all tables were complete. The developer then began to insert data using the following code shown in Figure 5.2.

```
INSERT INTO event (event_name, event_description, hemisphere)
VALUES ("Bootes", "The Herdsman", "North"),
("Cancer", "The Crab", "North"),
("Corvus", "The Crow", "North"),
("Crater", "The Cup", "North"),
("Leo", "The Lion", "North"),
("Virgo", "The Virgin", "North"),
("Cygnus", "The Swan", "North"),
("Scorpion", "The Swan", "North"),
("Sagittarius", "The Archer", "North"),
("Aquila", "The Eagle", "North"),
("Hercules", "The Warrior", "North"),
("Ara", "The Altar", "North"),
("Corona Borealis", "The Northern Crown", "North"),
("Pegasus", "The Winged Horse", "North"),
("Perseus", "The Greek Legend", "North"),
("Aquarius", "The Water Carrier", "North"),
("Aries", "The Ram", "North"),
("Capricornus", "The Sea Goat", "North"),
("Cetus", "The Sea Monster", "North"),
("Lacerta", "The Lizard", "North") ;
```

Figure 5.2 Insert SQL code to event table

Data insertion was only needed for the following tables; event, month, event_month and location. These tables would be holding static seasonal data on constellations that would be queried by the user. The remaining database tables would overtime be populated by users during registration and application usage. On completion of event data entry, the developer began constructing the MySQL query code. This is what will allow the user to

search the database, depending on their input. The user will be able to search for celestial events by entering their location and month of year.

This was made possible by the use of inner joins within the MySQL database, the following code was produced to find a celestial event using a location and month shown in Figure 5.3

```
SELECT event_name, event_description FROM event
INNER JOIN event_month
ON event.event_id = event_month.event_id
INNER JOIN month
ON event_month.month_id = month.month_id
INNER JOIN location
ON location.hemisphere = event.hemisphere
WHERE month_name LIKE "Entered Month"
AND city LIKE "Entered Location"
```

Figure 5.3 SQL Code to search event

This code combines the month, event, event_month and location table and outputs the event name and description when a match is made on the chosen location and month. When run this outputs a table of celestial events and their other known names shown in Figure 5.4.

event_name	event_description
Cygnus	The Swan
Scorpion	The Scorpion
Sagittarius	The Archer
Aquila	The Eagle
Hercules	The Warrior
Ara	The Altar
Corona Borealis	The Northern Crown

Figure 5.4 Output from MySQL query

5.3.2 API keys

The project will also require the use of API keys, these act as an authentication tokens to access resources. The resources being sought in this project can be accessed without an API key, but can have limitations applied as a result. To ensure full access is allowed the

developer will be using their personal API key for the functions where resources demand such authentication. The API keys attained will be from Nasa Developer portal. The project will access and manipulate data sets that Nasa have released for public consumption.

5.3.3 Database and Webpage Interaction

Webpage interaction with the database is required to enable users to login and access the core functionality of this web application. The connection was made using calls to the database in PHP script. This created a connection to the database, the webpage can now display data held in the database. The code used by the developer to create a connection is shown below in Figure 5.5 and 5.6. Figure 5.5 shows the require call on the connect_db.php. Figure 5.6 shows the actual code in the connect_db.php where the connection is made.

```
require ('..\connect_db.php') ;
```

Figure 5.5 PHP database connection by calling connect_db.php

```
<?php  
  
#connect on local host for user conor  
# with password 'trevor29' to data base 'site_db'.  
  
$dbc = mysqli_connect  
( 'localhost' , 'conor' , 'trevor29' , 'site_db' )  
OR die  
(mysqli_connect_error());  
  
#Set encoding to match PHP script encoding.  
mysqli_set_charset($dbc, 'utf8');  
?>
```

Figure 5.6 PHP that creates a connection with the database

5.3.4 The Star Hunter Function

This function was implemented using HTML and PHP. The star hunter information is stored on the database. These constellations are seasonal, so depending on the user's location and the time of year, it can be calculated what events will be viewable. As this information is static it was decided by the developer that this could be stored with minimal maintenance required. The constellation data was stored in the event table. This function was built up starting with a function that simply output data from the data tables. As development continued more aspects to this function were added. The next

stage produced output depending on city name or location entered. This was developed further to allow the month to be entered. Using the event_month table, the developer was able to link the events with the months they can be seen. This allowed the creation of a table that would show all events in a particular month. HTML was used to create structures which allow users to input their location and a month. These variables entered were passed to PHP using ‘\$_GET’, then put through ‘MySQL real_escape_string’ to protect the database from potential SQL injection. This protects the database from any attempt to append malicious code to a query. When a query resulted in events that are viewable to the user, these events are stored in an array. This array is used to generate a table of result for the viewer to review.

5.3.5 The Asteroid Hunter Function

This function does not access any data from the database, the developer wanted to access data from other sources and output them to the user. This would allow open access to useful data sets spread out over the internet. To create this function, the developer used cURL. This is a library that allows connections and communications to other servers. This library is used to access the relevant Nasa data sets. This function required up to date data sets of asteroids and their trajectory. The developer was able to source a relevant data

```

<?php
session_start();
// Method: POST, PUT, GET etc
// Data: array("param" => "value") ==> index.php?param=value

function CallAPI($method, $url, $data = false)
{
    $curl = curl_init();

    switch ($method)
    {
        case "POST":
            curl_setopt($curl, CURLOPT_POST, 1);

            if ($data)
                curl_setopt($curl, CURLOPT_POSTFIELDS, $data);
            break;
        case "PUT":
            curl_setopt($curl, CURLOPT_PUT, 1);
            break;
        default:
            if ($data)
                $url = sprintf("%s?%s", $url, http_build_query($data));
    }

    // Optional Authentication:
    // curl_setopt($curl, CURLOPT_HTTPAUTH, CURLAUTH_BASIC);
    // curl_setopt($curl, CURLOPT_USERPWD, "username:password");

    curl_setopt($curl, CURLOPT_URL, $url);
    curl_setopt($curl, CURLOPT_RETURNTRANSFER, 1);
    curl_setopt($curl, CURLOPT_SSL_VERIFYPEER, false);

    $result = curl_exec($curl);

    if($result === FALSE) {
        die(curl_error($curl));
    }

    curl_close($curl);

    return $result;
}
?>

```

though Nasa's open access data sets. Nasa holds data on asteroids and near earth objects, their data provide names of asteroid's, the date of their approach and how close they come to earth. This information is valuable to stargazers of all experience and will assist them in their night time viewing. The only requirement needed to access this data set, is an API key and also a start and end date, this set will then output asteroids approaching on those

Figure 5.7 cURL function used to create request to external data sets

connection built required a start and end date to get results. This data set will only return a search made, if the term is 7 days or less. If any attempt is made to return larger sets of data, it results in errors. To ensure the user had no difficulties making a request they are only able to enter a start date. The end date is automatically set to the date 7 days later. This manipulation is completed using PHP and the code shown below in Figure 5.8

```
$startDate = isset($_GET['start']) ? date('Y-m-d', strtotime($_GET['start'])) : false;
$endDate = $startDate ? date('Y-m-d', strtotime('+7 days', strtotime($startDate))) : false;
```

Figure 5.8 end date is set using the start date and adding 7

This allows the user to enter their chosen date, the cURL request will return events for that week. This will also save time for the user if their chosen date provides no results, they will be shown results for the rest of the week. The code in action can be seen below in Figure 5.9 and 5.10. The developer stores the essential start and end date with the API key, then uses the GET call to complete the call to the Nasa feed.

```
$params = array(
    'start_date' => $startDate,
    'end_date' => $endDate,
    'api_key' => 'coXJeNygdeuxVKs9yJLecWbfuXsY54Wi9gq37HuN'
```

Figure 5.9 Storage of start/end dates and API

```
$data = json_decode(callAPI('GET', 'https://api.nasa.gov/neo/rest/v1/feed', $params));
```

Figure 5.10 Making a GET request to the Nasa asteroid feed

5.3.6 The Forum function

Through discussion with the focus group, the ability to share events using a public forum was requested. This provides an opportunity to share knowledge with other stargazers. The developer used PHP and HTML to create this function. The forum is created by generating a table that outputs saved messages from the database. This connection is created using the connect_db.php discussed earlier in this chapter. The forum shows the

```
<div class="col-md-8">
  <form action = "post_action.php" method = "POST"
    accept-charset="utf-8">
    <p>Event Type:<br>
    <input name = "subject" type = "text" size = "64"></p>
    <p>When and where:<br>
    <textarea name = "message" rows = "5" cols = "50">
    </textarea></p>
    <p><input type = "submit" value = "Submit"></p>
  </form>
</div>
```

user who created the post, the date posted and the message posted. This offers users another field of knowledge to assist in stargazing. This Forum also provides the ability for users to post messages themselves. If they have information they would like to share, they can add to the forum and their message will be saved in the database. This function is achieved using \$_POST, the user can write out the message and click submit. The form created in HTML is shown below in Figure 5.11

This user input is then sent to post_action.php, from there the following code shown in Figure 5.12 checks that there is both a subject and message included before adding it to the database. Once it is added to the database it is now shown on the forum page.

```
if ($_SERVER['REQUEST_METHOD'] == 'POST')
{
    if(empty($_POST['subject']))
    {echo '<p></p>';}
    if(empty($_POST['message']))
    {echo '<p></p>';}

    if(!empty($_POST['subject'])
    && !empty($_POST['message']))
    {
        require('../connect_db.php');
        $q = "INSERT INTO forum
        (first_name,subject,message,post_date)
        VALUES(
        '{$_SESSION[first_name]}',
        '{$_POST[subject]}',
        '{$_POST[message]}',
        NOW())" ;
        $r = mysqli_query($dbc, $q) ;

        if( mysqli_affected_rows ($dbc) !=1)
        {
            echo '<p>Error</p>'.mysqli_error($dbc) ;
        }
        else
        {
            load('forum.php') ;
        }
    }
    mysqli_close ($dbc) ;
}
```

Figure 5.12 post_action.php code showing checks to ensure all fields are included

5.3.7 Image of the Day Function

This is another function selected from user stories and feedback from the focus group. The focus group sought the ability to view images of events. In order to provide this functionality, the developer used JavaScript to pass images from an external website. This website provided astronomy images that change daily, they also provide a short description from a professional astronomer. This was implemented through JavaScript

```
var url = "https://api.nasa.gov/planetary/apod?api_key=coXJeNvgdeuxVKs9yJLecWbFuXsY54Wi9gg37HuN";
```

Figure 5.13 API call through JavaScript

with the access being granted using the developer's API key. This is shown in Figure 5.13. This images and text information is then displayed using HTML to output on the page. The image displayed will change daily and provide the user with inspiration as well as information on each image. The code used to display the image and text is shown below in Figure 5.14.

```

<div class="row">
  <div class="col-md-8">
    <img id="apod_img_id" width="100%"/>
    <iframe id="apod_vid_id" type="text/html" width="640" height="385" frameborder="0"></iframe>
    <p id="copyright"></p>
  </div>
  <div class="col-md-4">
    <h3 id="apod_title"></h3>
    <p id="apod_explanation"></p>
  </div>
</div>

```

Figure 5.14 HTML code used to display image and explanation

5.3.8 Share Function

This function was included so that the user may share with friends and fellow enthusiasts results that interest them. This was a key function in assisting users to involve friends, it also makes this information public. This will increase access to the public and can also help increase footfall to the web application. The share function would run alongside core functionality so when users search for events or view the image of the day they can share a link with friends through email or social media. This function was provided by 'add this' and allow users to click on the pop up link and share. This was implemented by including the JavaScript code shown below in Figure 5.15.

```
<!-- share function provided by add this -->
<script type="text/javascript" src="//s7.addthis.com/js/300/addthis_widget.js#pubid=ra-577d1bcda482a381"></script>
```

Figure 5.15 JavaScript that applies share bar function to the page

5.3.9 HTML and CSS

This section proved to be the most challenging and time consuming, the application was separated into five main sections;

- Home page
- Forum page
- Star hunter page
- Asteroid hunter page
- Image of the day page

The original design plans were deemed not suitable for the final application. As development proceeded, the focus group were contacted for feedback on functions. Using feedback, the new design and layout was implemented. A navigation bar was implemented to aid site movement. This would be in addition to large icons for access to each main function. This would allow easier access for the user traveling throughout the application. The developer used CSS and HTML to maintain continuity throughout each section. This would allow the user to build confidence and feel more intuitive. The implemented layout is shown below in Figure 5.16 which shows continuity between pages.

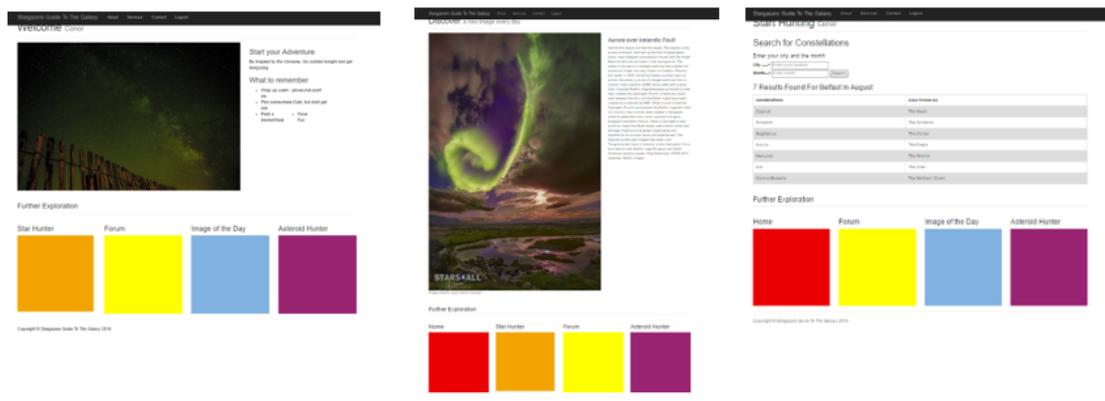


Figure 5.16 Display showing 3 pages and used of space and shapes to create continuity

During implementation the developer followed guidance given on W3schools.com, startbootstrap.com as well as example templates provided within the HTML & CSS design and built websites book. These resources assisted the developer through each stage of implementation.

5.3.10 Multi-Browser Implementation

Throughout implementation the developer used both GOOGLE CHROME as well as INTERNET EXPLORER when running functions. This ensured that the developer would be aware of any changes to output as implementation was occurring. The developer also included MICROSOFT EDGE as progress was made. This would ensure web application acted as expected across different platforms. This is illustrated below in Figure 15.17 showing the home page across EDGE, CHROME and EXPLORER.

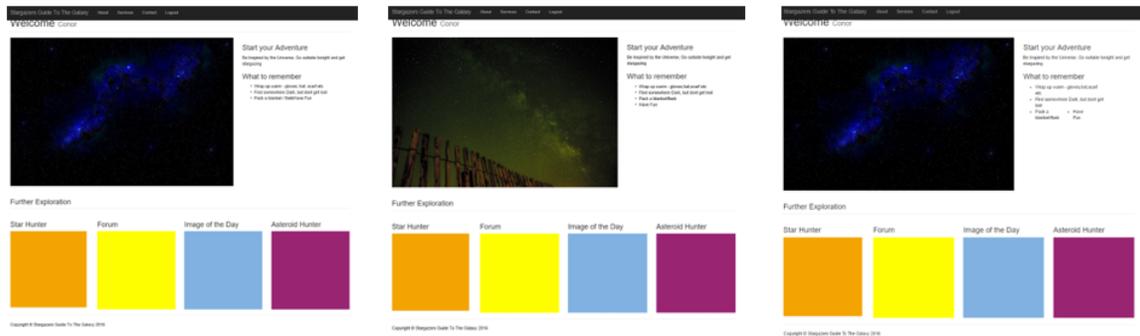


Figure 15.17 Home page through multi browsers

5.4 Summary

This chapter has detailed the implementation platform and the core functionality to achieve a successful implementation. Screenshots have been included of HTML, CSS, PHP, Java Script and MySQL to illustrate the implementation in action.

6 Testing and Evaluation

6.1 Introduction

This chapter shows the testing process completed on the stargazers' guide to the galaxy. This testing is performed by the developer in the first instance following the implementation of the website. This chapter will also present testing completed by the focus group. The results from this testing will be analyzed to evaluate the application.

6.2 Testing

Testing typically is thought to be left until the end, this is not necessarily the best option. It is important to test as you go, at each interval or stop test what you have built. This ensures a strong functional program is achieved. The developer followed this process throughout the implementation stage. Consistent testing throughout the build stage is important especially when timescales are tight. This ensures that the website will be accessible and functional no matter what device or browser is used.

The testing was completed using four methods;

- Developer testing
- Cross-Browser Testing
- Cross-Platform Testing
- Focus Group Testing

The testing was completed using an Asus laptop primarily, however other devices were sourced to test on they included;

- Google Nexus 6
- Apple iPad pro

6.2.1 Developer Testing

This testing was carried out by the developer to confirm all functionality has been achieved. This testing was completed using an Asus Laptop and the results are displayed below. This table shows the functionality achieved, this required the developer to go through each function and test that it was working as designed. The table shows all functions are operational.

Functionality	Login	Registration	Home-Page	Forum	Star Hunter	Asteroid-Hunter	Daily Image
Header Links	√	√	√	√	√	√	√
Footer Links	√	√	√	√	√	√	√
Navigational Links	√	√	√	√	√	√	√
Display of text	√	√	√	√	√	√	√
Database connection	√	√	√	√	√	√	√
Page Display	√	√	√	√	√	√	√

API connection	√	√	√	√	√	√	√
Image Displays	√	√	√	√	√	√	√
Table Displays	√	√	√	√	√	√	√

Table 6.1 Table displaying functionality across the application.

6.2.2 Cross Browser Testing

As the user may access this application through different internet browsers the developer deemed it essential to complete cross browser testing. This will include functionality testing across each browser and ensuring there was continuity with the applications presentation. The testing was completed across Google Chrome, Internet Explorer and Microsoft Edge. The results are shown below.

Criteria	Google Chrome Windows 10	Microsoft Edge Windows 10	Internet Explorer Windows 10
Web app layout consistent	√	√	√
Colour consistent	√	√	√
Images consistent	√	√	√
Navigation links	√	√	√
Header links	√	√	√
Footer links	√	√	√
Text output	√	√	√
Image Slideshow	√	√	√
Star Hunter function	√	√	√
Forum function	√	√	√
Asteroid function	√	√	√
Share function	√	√	√
Image of Day	√	√	√
Post function	√	√	√

Table 6.2 Table showing functionality across different browsers.

The results presented a successful testing across multiple platforms. This shows the “Stargazers Guide to the Galaxy” have achieved cross-browser compatibility.

6.2.3 Cross Platform Testing

The cross platform testing was completed using a google nexus 6 and iPad Pro. The aim, to ensure that functionality would be viable across other mobile devices. This would ensure user could access this application on any platform. This would be beneficial for the subject matter; this would allow users to access this application while outside on the go. The results are displayed in the table below.

Criteria	Apple iPad Pro	Google Nexus 6
Colour consistent	√	√
Images consistent	√	√
Navigation links	√	√
Header links	√	√
Footer links	√	√
Text output	√	√
Image Slideshow	√	√
Star Hunter function	√	√
Forum function	√	√
Asteroid function	√	√
Share function	√	√
Image of Day	√	√
Post function	√	√

Table 6.3 shows functionality across different platforms.

These results show that “Stargazers Guide to the Galaxy” again passed this element of the testing stage. Through testing it has shown that the layout is impacted by use of smaller devices and so further development would be needed to fully utilize the cross platform business.

6.2.4 Focus Group Testing

The focus group testing was completed using a set of five tasks and group were presented with questionnaires on how easy they found these tasks. A mark of 1 represents a very difficult experience and 5 as a very easy experience. The results were calculated and displayed in a table below. The focus group were also asked for feedback if any improvements should be made or errors incurred whilst testing. The results were found to be very positive with a slight dip in marks during usage of the asteroid function, some users requested a different format for results output.

Scenario	Average Mark	Final outcome
Open of web application and register for access	4.6	Pass
Find the Star Hunter function and look for event in your area	4.4	Pass
Find the Image of the Day Function	5	Pass
Access the Forum and try to add a post	4	Pass
Access the Asteroid Function and find out the next asteroid to pass the earth	3.8	Pass

Table 6.4 Table of scenario testing results.

6.3 Summary

This chapter detailed the testing carried out by the developer and displayed the results in table format. These results show functionality was achieved and performing as required. This confirms that implementation was successful across multi- browser and multi-platform. This chapter also displayed findings from the focus group testing. This testing further concluded that implementation was successful. The inclusion of focus group testing allowed the developer to gather feedback for further developments also.

7 Conclusions

7.1 Introduction

This chapter will summarize the steps taken during development of the project from initial problem to testing. It will also review work completed by the developer. It will establish whether this project fulfills the initial requirements set out. Overall success of the project will be evaluated and recommendations made for further development will be included

7.2 Project Appraisal

The developer started this project with the aim, 'to develop a web application that can collate data regarding celestial events that is spread out over the internet and provide it for users to access'. This led the developer to establish a set of objectives, these would ensure success in achieving the aim:

- Review of applications and websites currently available to Stargazer enthusiast, noting strengths and weaknesses.
- Create a questionnaire that would be completed by the project focus group.

- Agree on a set of functional and non-functional requirements based upon focus group feedback.
- Design the application structures to incorporate the functional and non-functional requirements.
- Implement the design and test with focus group.

The first objective was achieved in Chapter 2, the author completed a review of literature available on Stargazing as an activity. This unveiled many benefits to the individual, this activity would benefit both the mental and physical health of the individual. This Chapter also revealed that communities could benefit financially through Star tourism. The benefits would also impact the environment through reduction of light pollution and energy consumption. This Chapter also researched applications and websites already available to the individual. These applications were assessed by the author and results shown in table form. These applications did not provide the service set out in the aim. While they offered useful information they did not offer a celestial database of events. This showed a potential gap in the market for such an application.

The second and third objectives were approached and completed in Chapter 3. The author assembled a focus group and circulated a questionnaire. This would allow end-user requirements to be established. The questionnaire was sent out to 12 participants, 6 women and 6 men. These individuals varied in stargazing competence, from beginner to experienced. The feedback received was collated and a set of user stories were generated. These user stories became the basis of the functional and non-functional requirements. These functional requirements would become the foundation of the web-application design.

Chapter 4 focused on the design of the application, showing how the requirements would be incorporated into the project. This section also discusses the structures required for functions. The database design was finalized, the platforms and developer languages agreed upon. The developer also discussed approaches on user interface design and guidelines for good design. The author has achieved the fourth objective in this chapter.

The final objective set was to implement the design and carryout testing. Testing would be completed in house by the developer although, the focus group would be consulted for additional testing. Chapter 5 shows the implementation taken by the developer, recording functionality achieved. This Chapter shows some multi-browser testing carried out by the developer, the majority of testing is shown in Chapter 6. The implementation is shown function by function and the achievements made. The testing of the project is completed and results shown in table format. The testing completed showed a successful implementation with functions working across browsers and platforms. It also included results from focus group testing, to show user interaction. This testing was positive and also brought up further development for this project.

7.3 Project Review

This web application was designed and developed using PHP, HTML, CSS, MySQL and JavaScript. The testing was completed on a ASUS X555LAB laptop, intel core i5-200U 2.20GHz 8Gb RAM and 64-bit Windows 10. Testing was carried out by developer and by their focus group. This testing was completed to evaluate the success of the application and overall success of the project.

The author discusses above the objective set out and the success in achieving them. The developer has created an easy to use web application, following simple navigation the user can access all functions. The developer made use of text, images and colour to help users navigate. The user is able to register/login and search for celestial events in their area. The ability to access data the user needs will help increase stargazing and interest in the field. The user can access stored data from the database alongside data collated from external sources. The applications inclusion of a forum will allow users to share their knowledge with other like-minded people. This will open up other sources of knowledge to the user.

The overall success of the project was achieved through defined objectives and detailed research. The design methodology followed was key to the success. The developers use of an agile approach to implementation enabled a step by step approach for each function. This allowed for timely completion and full functionality. The developer found this approach appropriate to ensure time frames were not extended and deadlines missed.

7.4 Recommendations

The project was successful in achieving the goals set out however through testing and focus group feedback some further development was discovered, these areas for further improvement are discussed below.

- Guest user facility, the application currently requires user to register to gain access. It would be beneficial to allow non-members to access the information as well.
- A good addition to the application would be if users could also share images taken with fellow members.
- The forum would benefit from further expansion to include admin and a possible trending feature for hot topics.
- A facility to allow users to save an event to a personalized calendar for future reference.
- Increase more functionality and expand on external sources the user can access i.e. other celestial events eclipses, planets.
- A function that allows a user to organize a group stargazing night and invite other members

- Additional information on how users can view specific events and what to look for.

7.5 Summary

This project was developed to bring together data on celestial events, to assist stargazers with their night time viewing. It aimed to overcome a knowledge gap that might hinder stargazers in their ability to view night time events. This application was developed as source of education and a tool to increase interest and participation in this area. The developer wanted to show this application is a viable product and could be expanded outside of the North of Ireland. Overall the developer believed this project to be a success in achieving the goals set. This application shows scope for expansion and could provide a sound resource for stargazers.

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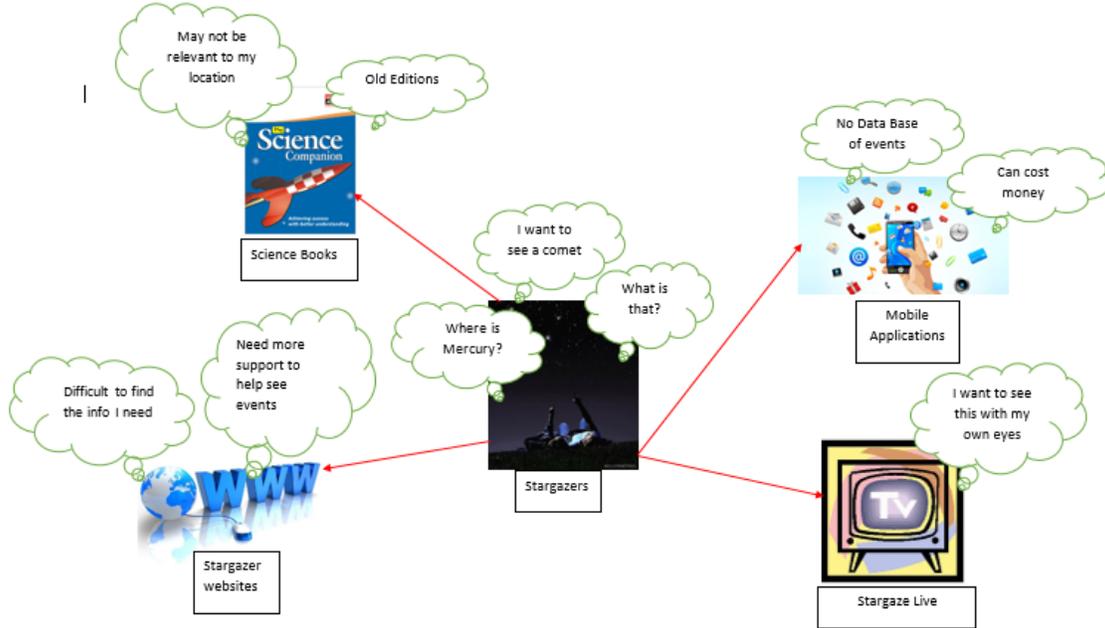
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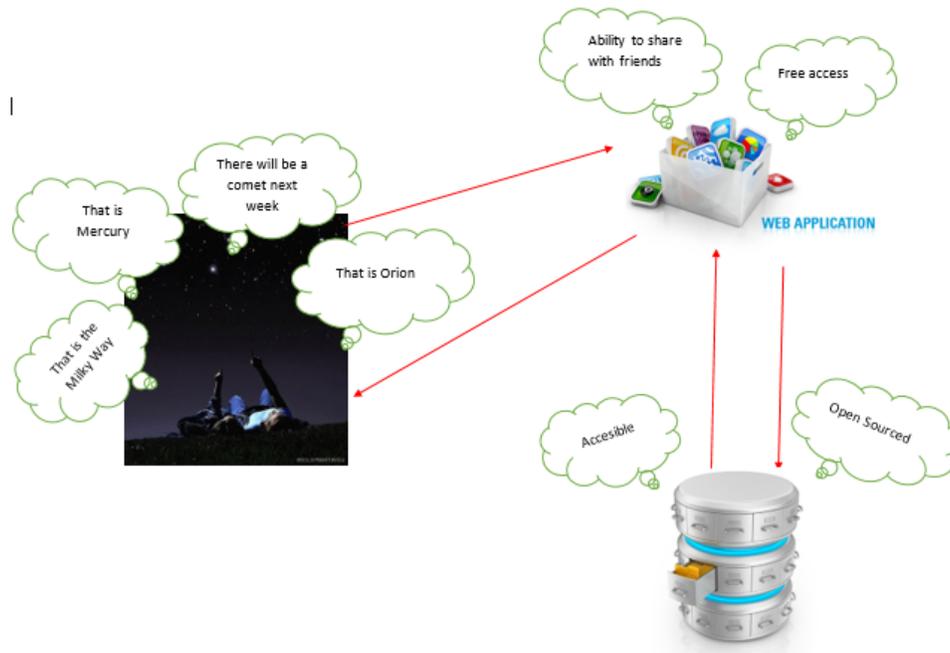
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Appendices

A1 Rich Picture of Problem



A2 Rich Picture of Solution



A3. User Requirement Questionnaire

The Stargazers Guide to the Galaxy

User Questionnaire

The questions contained in this questionnaire relate to the preferred design, features and presentation of a web based app which holds a data base of celestial events. The results will be used to guide the development of the application.

INTRODUCTION

Q1 Please indicate which of the following applies to you:

Please tick all that apply

- | | |
|---|--------------------------|
| I would describe myself as a Stargazing Novice | <input type="checkbox"/> |
| I have some experience Stargazing | <input type="checkbox"/> |
| I stargaze regularly and can spot some constellations | <input type="checkbox"/> |
| I stargaze weekly and can identify all constellations | <input type="checkbox"/> |
| I spend time every night Stargazing and can identify planets and constellations | <input type="checkbox"/> |

Q2 Please indicate whether you agree with the following statements:

Please tick for each statement

- | | Agree | Disagree |
|---|--------------------------|--------------------------|
| I enjoy Stargazing | <input type="checkbox"/> | <input type="checkbox"/> |
| I think a data base of celestial events would be beneficial | <input type="checkbox"/> | <input type="checkbox"/> |
| I would use a Stargazing web application | <input type="checkbox"/> | <input type="checkbox"/> |

Q3 Please indicate which of these stargazing resources you are aware of, which you have used and which you would recommend?

Please tick all that apply

	Aware Of	Have Used	Would Recommend
BBC Stargaze http://www.bbc.co.uk/programmes/b019h4g8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stargazing for Beginners National Trust https://www.nationaltrust.org.uk/features/stargazing-for-beginners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nasa Spot the station http://spotthestation.nasa.gov/sightings/view.cfm?country=United_Kingdom&region=Northern_Ireland&city=Belfast#.VpZXM2YrFPZ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

APPLICATION CONTENT & STRUCTURE

Q4 Please rate the importance of the following functions from "very important" to "not at all important":

Please tick one box in each row

	Very Important	Quite Important	Neither Important nor Unimportant	Not very important	Not important	Don't know
Data Base of celestial events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tips on how to view celestial events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Share results from search with friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reminders of upcoming events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Images of Events for reference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please use space below to suggest any other feature you would like to see.

Q5 Please indicate how important you rate the following additional functions:

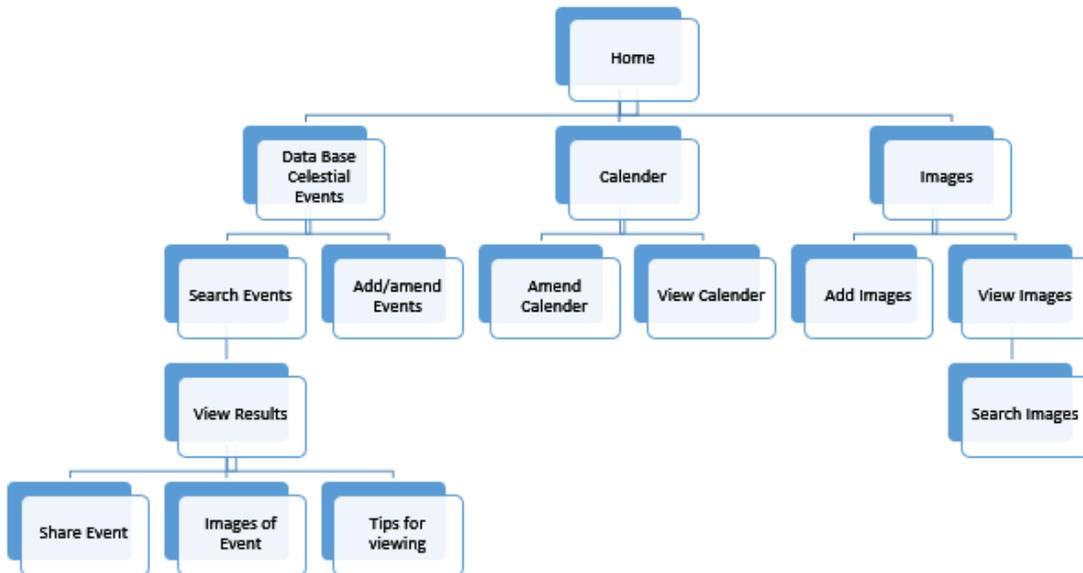
Please tick one box in each row

	Very Important	Quite Important	Neither Important nor Unimportant	Not very important	Not important	Don't know
Personalised Login facility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ability to save events to personalised calendar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ability to add and share images taken on Events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ability to add to the data base of celestial events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blogs to share helpful tips and advice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

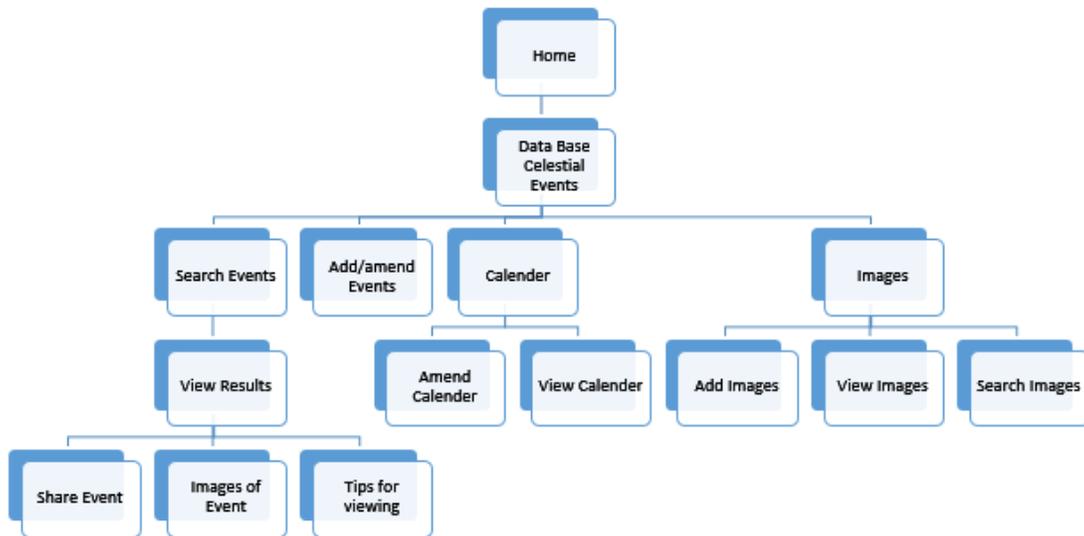
Q6 Please indicate which structure you think is most appropriate:

Please make only 1 selection

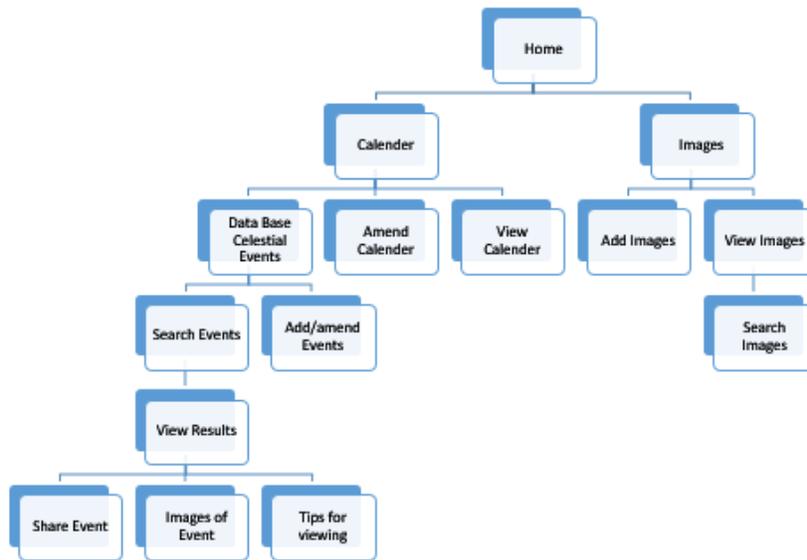
Structure A



Structure B



Structure C



|

APPLICATION PRESENTATION

Q7 Please indicate whether the following font families are suitable or unsuitable by ticking the appropriate box.

Please tick one box in each row

	Suitable	Not Suitable	Don't Know
Generic Serif Family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generic Sans-Serif Family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generic Monospace Family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Generic family	Font Family	Description	
Serif	Times New Roman	Serif fonts have small lines at the ends on some characters	SG
	Georgia		
Sans-serif	Arial	"Sans" means without - these fonts do not have the lines at the ends of characters	SG
	Verdana		
Monospace	Courier New	All monospace characters have the same width	SG
	Lucida Console		

Q8 Please select which colour scheme you feel is most appropriate for a Stargazing Web App.

Please note that these designs are mock ups, and note the final design.

Please make only 1 selection

A



B



C



D



E



Q9 Please indicate if you would be willing to test the application once available?

Please tick one box

Yes

No

I am willing to help with testing

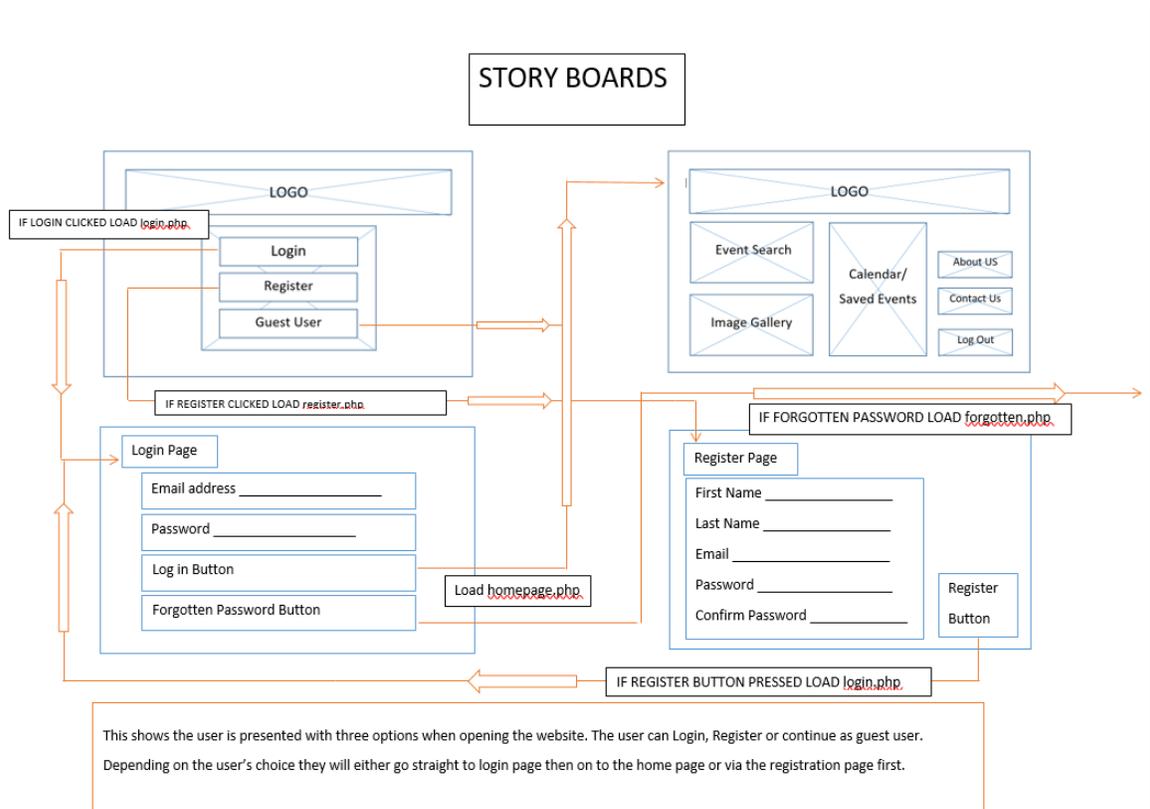
Please enter your details if you agree

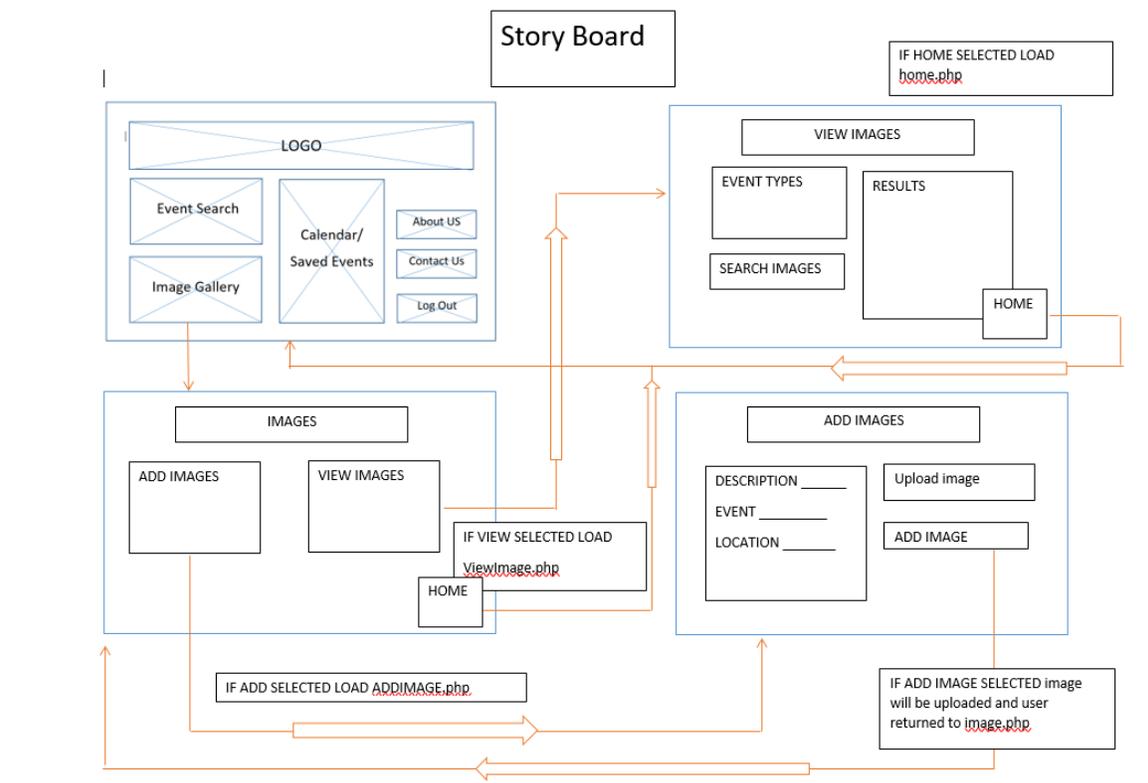
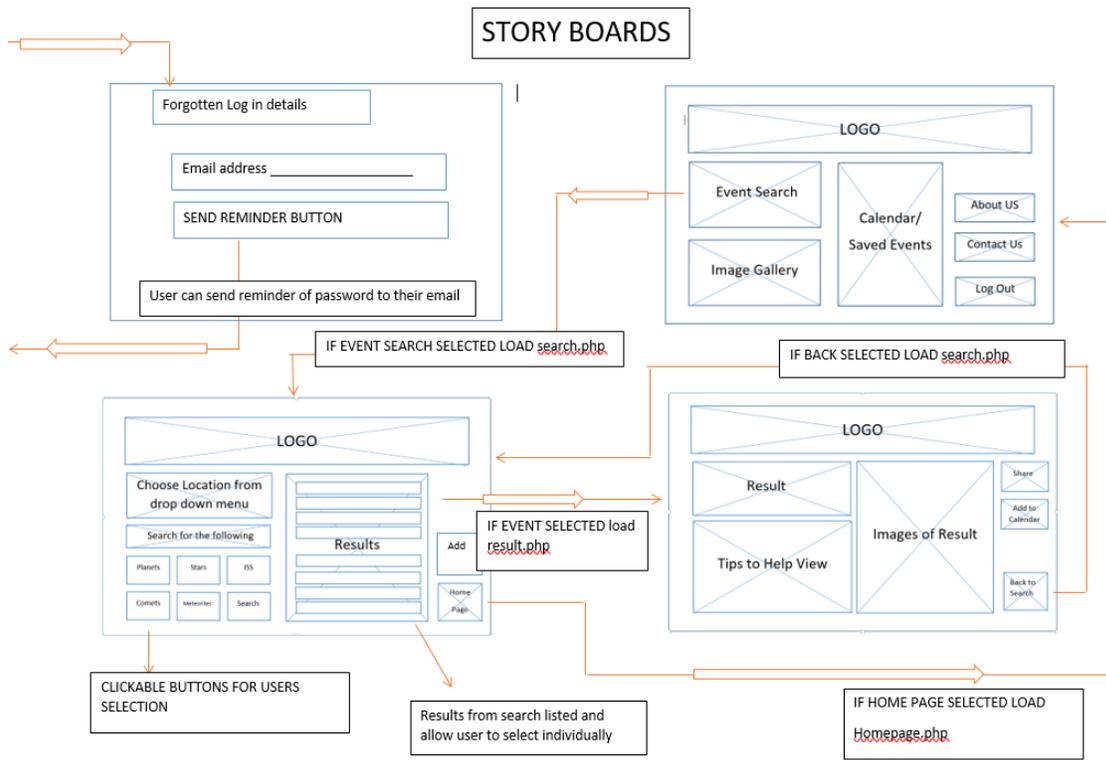
Print your full name:

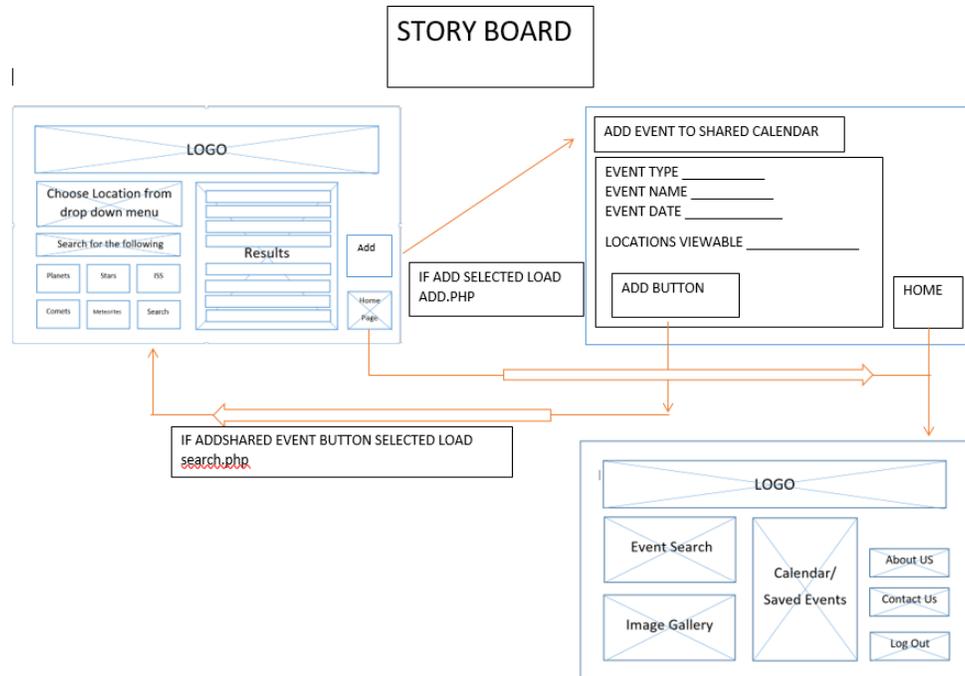
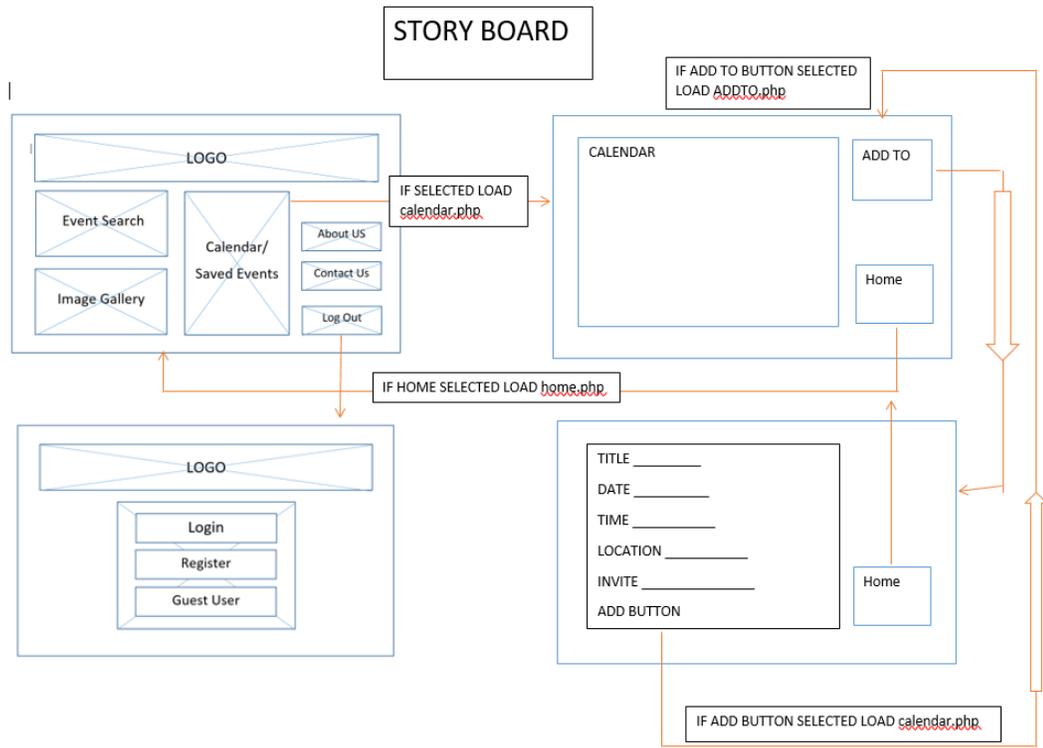
Email Address:

Thank you for your assistance.

A4. Initial Wire Frame Mock ups







A5 Final layout

Stargazers Guide To The Galaxy About Services Contact Logout

Welcome [Conor](#)



Start your Adventure

Be Inspired by the Universe, Go outside tonight and get stargazing

What to remember

- Wrap up warm - gloves, hat, scarf etc
- Find somewhere Dark, but dont get lost
- Pack a blanket / flaskHave Fun

Further Exploration

Star Hunter	Forum	Image of the Day	Asteroid Hunter
-----------------------------	-----------------------	----------------------------------	---------------------------------

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DISCOVER a new image every day



Image Credits: Colleen Pinski

Annular Solar Eclipse over New Mexico

What is this person doing? In 2012 an annular eclipse of the Sun was visible over a narrow path that crossed the northern Pacific Ocean and several western US states. In an annular solar eclipse, the Moon is too far from the Earth to block out the entire Sun, leaving the Sun peeking out over the Moon's disk in a ring of fire. To capture this unusual solar event, an industrious photographer drove from Arizona to New Mexico to find just the right vista. After setting up and just as the eclipsed Sun was setting over a ridge about 0.5 kilometers away, a person unknowingly walked right into the shot. Although grateful for the unexpected human element, the photographer never learned the identity of the silhouetted interloper. It appears likely, though, that the person is holding a circular device that would enable them to get their own view of the eclipse. The shot was taken at sunset on 2012 May 20 at 7:36 pm local time from a park near Albuquerque, New Mexico, USA. Tomorrow another annular solar eclipse will become visible, this time along a path crossing Africa and Madagascar. Free Download: APOD 2017 Calendar: NASA Images

Further Exploration

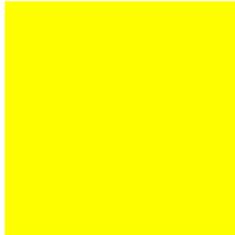
Home



Star Hunter



Forum



Asteroid Hunter



Members Forum share your knowledge

Posted By	Post date	Subject	Event Details (include dates of event)
conor	2016-06-22 17:50:09	Lunar Eclipse	This will be next Wednesday 3rd July There is a great viewing location on Cave Hill
Bernie	2016-06-23 23:11:06	Comet	There will be a comet next week viewable on Wednesday from 10pm
Rhea	2016-07-13 16:54:48	Planets	You will be able to view Venus on the 20th July from Belfast
Conor	2016-08-17 18:16:56	Comet	There is going to be a comet on the evening of 01/09/16
Conor	2016-08-29 10:59:53	Constellation	The Constellation Andromeda will be viewable best in October and November
Conor	2016-08-29 17:34:32	Asteroid Shower	There is going to be an asteroid shower this week viewable in Derry

Share with Others

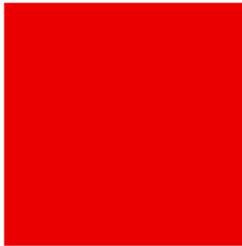
Remember to include

- type of eventdate of the eventany tips for viewing

[Post to Forum](#)

Further Exploration

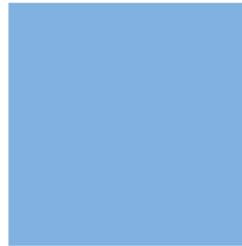
[Home](#)



[Star Hunter](#)



[Image of the Day](#)



[Asteroid Hunter](#)



Start Hunting Conor

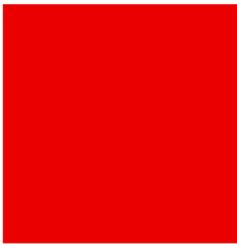
Search for Constellations

Enter your city and the month

City →
Month →

Further Exploration

Home



Forum

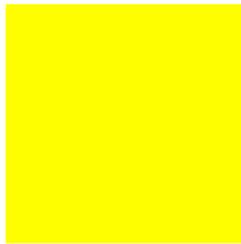


Image of the Day



Asteroid Hunter



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Welcome Conor

Search the Skies for Asteroids

Asteroid Report

Please enter your selected date :

Further Exploration

Home



Star Hunter



Forum

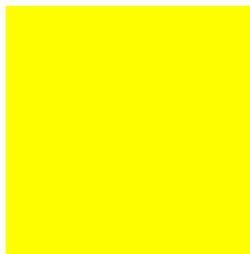
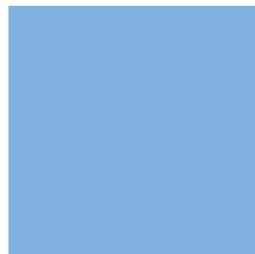


Image of the Day



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A6 User Testing Results

The Stargazers Guide To The Galaxy

User Defined Testing Scenarios

User: _____

The user is asked to complete 4 tasks and to rate the ease of using this application. These tests were determined to how users would interact with the application and the navigation

Scenario 1

Register with the application and Login to home page.

How would you rate this ease of this task?

Very Difficult	Difficult	Average	Easy	Very Easy
1	2	3	4	5

Scenario 2

Access the Star Hunter function and look for an event in your location

How would you rate this ease of this task?

Very Difficult	Difficult	Average	Easy	Very Easy
1	2	3	4	5

Scenario 3

Access the Image of the Day function

How would you rate this ease of this task?

Very Difficult	Difficult	Average	Easy	Very Easy
1	2	3	4	5

Scenario 4

Access the Forum function and add a post

How would you rate this ease of this task?

Very Difficult	Difficult	Average	Easy	Very Easy
1	2	3	4	5

Scenario 5

Access the Asteroid Hunter function and find out the next asteroid to pass the earth

How would you rate this ease of this task?

Very Difficult	Difficult	Average	Easy	Very Easy
1	2	3	4	5

Further Comments

The Stargazers Guide To The Galaxy**Focus group testing**

User: _____

This test is to determine the success of shortfalls of the application, this will help assist further development of this application

1. Is the Login function easy to complete?

Very Difficult	Difficult	Average	Easy	Very Easy
1	2	3	4	5

2. Did you find the Home page easier to maneuver?

Very Difficult	Difficult	Average	Easy	Very Easy
1	2	3	4	5

3. Did you find the information clearly presented and easy to understand?

Very Difficult	Difficult	Average	Easy	Very Easy
1	2	3	4	5

4. Was the design of the user interface appealing?

Very Poor	Poor	Average	Appealing	Very Appealing
1	2	3	4	5

5. Do you think the Functions are easy to use?

Very Difficult	Difficult	Average	Easy	Very Easy
1	2	3	4	5

6. Did the application respond quickly to your requests?

Very Slow	Slow	Average	Fast	Very Fast
1	2	3	4	5

7. Did you encounter any errors or issues?

Many	Some	None
1	2	3

8. Would you use this application again in the future?

No	Maybe	Yes
1	2	3

9. Do you have any recommendations to improve the application for future development?
