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Final Stage Computing Project

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BSc (Hons) Computer Science

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Bird Buddy

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Abstract

Bird watching is a hobby that is enjoyed by millions of individuals throughout the globe annually. This project has been pursued as the developer has an interest in bird watching and photography. The project has taken many different shapes over the past year from the initial thought of the project in June 2016, to the submission of the PID in January 2017.

This report discusses in detail the processes used throughout this project from the analysis of requirements to the development of the android application and the website for Bird Buddy. The services have been developed by the developer as a tool to enhance the bird watching experience.

Although there is no real client for this project, the developer has been gearing the requirements based off his opinions, with assistance from his project supervisor and people in the bird watching community that the developer has been in contact with online.

This report finishes with an evaluation of the work completed. This is done through the end project report, user evaluation, project post-mortem and conclusions gathered at the end. The purpose of these evaluations is to see whether the requirements have been reached and to see how the expected clients would react so such an application.

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Word Count = 10,996

1. Introduction

This report discusses the development process and the various methods used throughout this project, in the development of the Bird Buddy application and website. In this report, the technologies used throughout this project as well as the project management techniques used to create the applications will be looked at in detail.

The result has been an Android application with a complimenting website used for bird watching. The Android application allows users to log their own sightings. Each sighting contains: the username of the logger, the date and time of the sighting, the bird that was seen and the longitude and latitude where the bird was seen. This information is then stored in a MySQL database hosted on EcoWebHosting and encoded to the user in form of JSON arrays. The user is also able to view an array of sighting information about each bird.

Throughout this report, the reader will be able to view the requirements and objectives achieved throughout the project. They will also be able to see the processes used to reach the final iteration of these applications. Furthermore, the report will conclude with a project post- mortem and conclusions drawn by the developer about the overall experience of the project and the end software developed.

2. Background

2.1 Project Background

Throughout the development of this project, there has been no real client. The project reflects my personal interests (bird watching and photography). However, through user testing and asking various communities, the requirements have been selected accordingly.

Android has been the selected operating system for the project as the developer has a lot of experience using this. This limits the user base to users with Android devices. Anyone with access to the internet can see the distribution of the data. However, if you are only accessing the information on the website, you will not be able to log data entries. When looking at the development process, Android was always going to be the chosen operating system. Xamarin was briefly looked in to before the development process started.

The app has been developed for use by Bird watchers and nature enthusiasts. By storing your sightings on your phone, you will no longer need to bring a notebook and pen with you when birdwatching. This is also a much easier way of communicating with your friends/ followers the birds that you have seen.

2.2 The Aim

The overall aim for this project was to provide an Android based application with an intuitive interface for users to log their bird sightings and view them remotely. The project will also develop a website where users can view the overall data whilst not removing any data integrity. The final aim was to allow the developer to gain useful skills revolving around the development of integrated systems and project management.

Through preliminary research in to the bird watching communities, it was discovered that there are almost three million bird watchers in the UK aged over 15 (The RSPB, 2006). This information demonstrates a clear target audience for this application.

Unfortunately, finding the specific age of these watchers proved more difficult than anticipated. From experience and community knowledge, bird watchers appear to be over 40. Consequently, a minimalist approach was taken during the development of the application and website. Too much information on the screen would clutter the interface. Maintaining the usability has been a key factor in the development process. User testing has taken place to ensure the app functions as expected.

2.3 Project Objectives

- Analyse existing systems used by bird watchers to understand their requirements, creating improvements based on this.
- Provide users with a list of birds that they will be able to see throughout the country.
- Provide users with the ability to learn more information about each bird.
- Allow users to view the last sighting of each bird.
- Allow users to view the place that they will be most likely to view the birds.
- Allow users to log their own data entry points.
- Provide users with a list of their logged data entry points, showing the time and position that it was logged.

2.4 Minimum Requirements

The minimum requirements for this project are listed below. You can also view the minimum requirements to run the actual software in Appendix A.

- To have an Android based application that allows the user to log information about a bird sighting whilst being able to view this at a later stage with all their other sightings. The user must also be able to view information about each bird in the database.
- For the website, be able to view your logged data in one place. You must also be able to view the data about each available bird in a way that is informative and beneficial to the user.
- The user must be able to view a visualisation of the logged data points for each bird.
- There should be an option to register for an account or continue as a guest if they so choose.

2.5 Assumptions

- The user will have an Android phone running at least Android 5.0.
- Any server downtime is uncontrollable and will be treated as such.
- The user will have location enabled on their Android device and web browser.
- The user will be using any web browser.
- The user will have at least a basic understanding of the navigation of a website.
- The user will be accessing the website from a desktop/ laptop.

3. Requirement Research

This project has required a lot of background research in to assorted topics before the initiation of any software development. This included research in to the various information that would be collected about the different birds. The information about each bird was collected from the RSPB website or various other sources. The list of information collected about these birds has been attached as Appendix AA.

4. Method of Approach

4.1 Approach

Agile has been used throughout this project when it comes to the development process. Agile was selected, as the requirements for the project were not set in stone upon initiation. Before the development had begun, a lot of alterations to the core requirements for the project were made. These changes can be seen between the PID and the Proposal. (The proposal and PID have been attached as Appendix C). The initial plan for this project was to have an Android application that would identify birds for the user based on pre-set questions. After researching in to the need for such an app, it was discovered that the people likely to use the app would already have the required knowledge to identify the birds. However, there is a distinct lack of applications that allow users to log their sightings effectively.

Whilst Agile has been used as the core approach for this project, PRINCE2 has also been used for the project management aspect. Although Agile is highly successful for development, it often lacks an effective project management technique. Due to this, the project management is often overlooked. To avoid such an issue occurring, the project will follow aspects of PRINCE2 when it comes to planning. This includes a project plan, stage planning and exception reports. The reader will also be able to view risk management reports and post-project reviews throughout this report. Throughout the project, multiple development stages were completed, as per the PRINCE2 requirements. The stages have been short to allow more control over the project.

4.2 Tools

Throughout this project, there have been many different tools used. A full list of the resources used can be seen in Appendix F. The main tools used throughout this project were Android Studio (version 2.1.3) for the development of the Android Application. This has been programmes using Java. PHP Storm was used for the development of the website. NetBeans 8.0.2 was used for the development of the middleware between the Android client and the database. MySQL workbench was used for the development of the database. AWS control panel was used for the management of the server side functionality. These

were my intended tools of usage. However, after changing from AWS to EcoWebHosting (EcoWebHosting, 2017), the server side scripts have been created using PHP Storm, with phpMyAdmin for the database.

5. Processes

5.1 Process

Throughout this project, a combination of Agile and PRINCE2 were used. PRINCE2 has primarily been used for the project management aspects, including the creation of a PID. Whereas, Agile has been the main technique used for the development process. However, both are equally crucial to the completion of this project. There has been a lot of documentation along the way to ensure that the plans have been stuck to, and to ensure the most effective and efficient software possible.

5.2 Prototyping

During this project, multiple prototypes have been created for the Android client. These can be seen in Appendices G through to I. The appendices include a thorough evaluation in to the development process of the designs. For the Android application, the developer firstly created a paper based model of the application. A small video detailing a basic run through of the core functionality as suggested in the project plan has also been created to ensure that all the functionality points are accounted for and to make sure that they work together. These designs have then been transferred across in to Android Studio using XML documents. This created the first functional prototype for the application.

After the first prototype was complete, the designs were shown to the supervisor for reassurance. The designs were then evaluated later in the development process as seen in Appendix J. All the above have been crucial in concreting the final designs used in the Android Application.

Around the same time, a prototype was then created for the website consisting of a basic implementation of the functionality point. This prototype included a login screen, register screen and a core home screen with an implementation of the Google Maps API. The design documentation has been created with a similar look and feel to the Android application. This can be seen as Appendix K.

Throughout the development of the Android application, three separate Android devices were used to ensure the application runs efficiently on different operating systems and different screen sizes. These devices have been running Lollipop, Marshmallow and Nougat. In doing so, minor adjustments have been made to ensure that the application will run on the above devices and operating systems.

One problem with Android, is that there are many different types of operating system, and varying pieces of hardware. My application will run on any Android Mobile running at least Android Lollipop.

5.3 Control Plan

The following techniques for control have been implemented throughout this project:

- **Weekly Highlight Reports:** These documents have been crucial for sticking to the intended plan and showing where more focus needs to be placed.
- **Weekly project supervisor meetings:** These have been beneficial for reviewing completed work and looking for guidance in the future.
- **Risk Management:** Before making any of the changes, the risks have been looked in to and calculated to ensure the consequences are taken in to consideration and contingency plans are in place.
- **End Stage Reports:** The list of End Stage Reports can be seen attached as Appendix E. An End Stage Report was created for each stage to ensure all the relevant documentation was accounted for and to help stay on track.
- **Exception Reports:** Throughout this project a single Exception Report was created during Stage 4. The form was filed due to an unavoidable error that wasn't taken in to consideration at the beginning.
- **Quality Plan:** Throughout, the work completed has been evaluated carefully to ensure the highest quality has been created. This has been done through setting out a design plan at the beginning of the project and sticking to it. Very few changes have been made to these designs. The design documentation has been attached as Appendix J.
- **Source Control System:** Throughout the duration of this project, BitBucket has been used on almost a daily basis. This was to ensure that if a hardware failure takes place, a recent copy of the code is available.

The hours undertaken each week were documented. This can be seen in Appendix M.

5.3.1 User Interface

The user interface was created with Google's material design in mind. The google developer website was looked at in detail when selecting the used designs for the Android application (Material design guidelines, 2017). This process was initiated by creating the iconography and designs for the Android Application. Then the initial prototype was created and the colour scheme and general layout was adapted for use for the website.

The user interface is crucial to any program. Having an intuitive design is something that was strived for during this project. Simplicity in the interface is necessary for users of all technical abilities. For this reason, the interfaces created for the Android Application were implemented with minimalization in mind (Fig. 1). The initial concepts were created by hand. Then enhancements were made by looking at existing applications to ensure what was being created would be beneficial for the users.

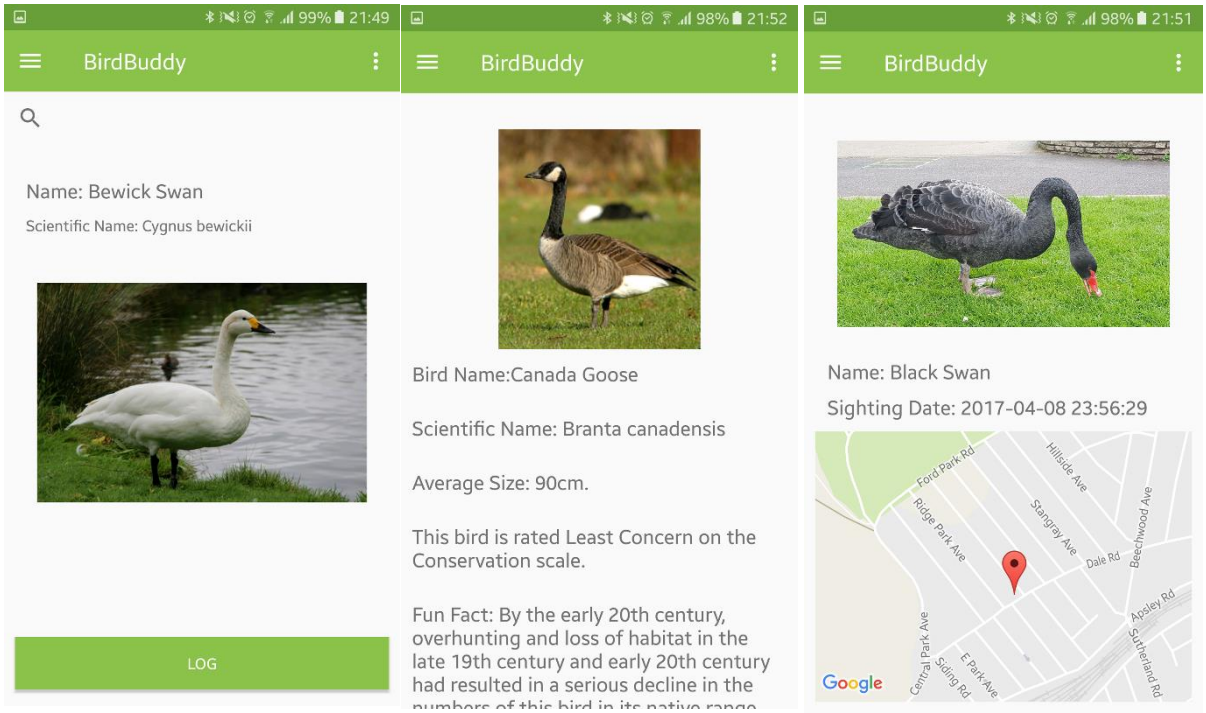

Figure 1: Images of the application interface.

These images show the simplicity that was strived for in the design process. There isn't too much information on the screen at any one time. Minimalization has been very important during the development of this application.

For the website, bootstrap 4.0 is in use as a framework (Mark Otto, 2017). Whilst there are lots of frameworks openly available to download, Bootstrap is one of the most popular and well documented. For this reason, it seemed like a suitable choice for the web side of the project.

5.3.2 Server Side

The chosen hosting organisation has been EcoWebHosting. This is a hosting company that hosts over 70,000 websites. They are also an environmentally friendly hosting option with its servers being run through renewable energy. The initial choice for hosting was Amazon's AWS. An AWS account was created using the free tier option available that is offered for a twelve-month period.

However, it was quickly discovered that the free tier wouldn't be sufficient for the project's needs, as it is very limiting in what you can do. Whilst everything is free, you only have a set quota. It was discovered that there would potentially be a considerable charge for the functionality that has been developed in this project. During this stage, many hosting options were looked in to, including Microsoft Azure, AWS and many LAMP stack (Linux Apache MySQL PHP) services. PHP will be used as the server side language.

EcoWebHosting offer many benefits over AWS for this project. A web mail server can be setup at no additional cost, and unlimited database configurations. They also offer unlimited web space. Whilst this option is more expensive now, the AWS student account is only available for a year. After this time, the cost would be far greater than anticipated. This is okay for large organisations, however as a side project after university it won't be financially plausible. Therefore, using EcoWebHosting will be cheaper in the long term and will allow the project to continue after university has finished. Whilst this would be possible if hosted with the university, changing the configuration settings would make things more complicated than necessary.

As PHP is a language that the developer has no experience working with, this has been a slight challenge. To get to grips with the language, some initial scripts were developed, including the creation of the registration, login and feedback form before developing the middleware. This allowed for a brief introduction to the language before developing the middleware. It is worth noting at this stage, the middleware is not true REST. True REST requires the parameters to be visible in the URL bar.

PHP was chosen as the Server side language for an array of reasons. There is a lot of integration available with PHP, especially with MySQL databases. This is something that has been used to its fullest potential in this project. The PHP scripts created have been a crucial point for a lot of the functionality. Without them, developing this project would have been a lot harder.

5.3.3 Database

During this project, a MySQL database will be used to store the sightings of birds. The database will also include the information about the conservation status and a fact about the birds. When looking in to the database development, many options were considered. This information can be found in Appendix R.

Whilst developing the database, the storage of images was a controversial topic. After discussion with the developer's supervisor, it was decided that the images would be stored as BLOB images within the database instead of calling upon a location in the server. This was done for integrity purposes and due to the supervisor's advice.

However, this was changed later in the development process to be a file location on the server. This was changed due to the implications of downloading 50 images on to the android device. When it came to the JSON encoding of the data, having actual images made this a complex process. Whilst base64 encoding was a potential option during this process, this involves the images becoming up to 1/3 larger than the actual stored image. This can be difficult for mobile networks. Even if the images are only 2mb each, that makes for over 130mbs worth of data being sent to the phone on each request.

5.3.4 Android

The Android platform was selected due to prior development using Android Studio through PRCO205. The developer has been using Android for the past six years, which was also a crucial factor in deciding to use Android. Market research was completed, that can be seen in Appendix L, regarding the target audience and found that of the 25 responses, Android users were most likely to use the application.

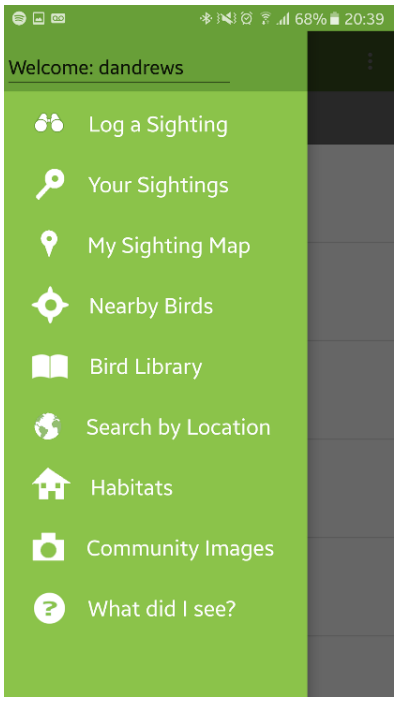

Figure 2: Android Navigation Drawer

This is the Navigation Drawer figurethat you can find within the application (Fig. 2). Most of the main functionality points can be found here. When looking at the layout that would be used for the application, it had always been my intention to store the functionality in a Navigation Drawer. The alternative would have been a tabular layout.

One of the main reasons this style wasn't selected was down to the restrictions in place in using tabs. There must be no more than six tabs on any given screen. This would mean the tabs would have to be scrolled to view all the functionality points. As simplicity has been the main ambition for this project, a Navigation Drawer is much better suited to this need.

If the user is logged in they will have their username where it says "welcome: dandrews". Initially, the top section of

the navigation drawer was going to be the Bird Buddy logo with the word Bird Buddy next to it. This was changed early in the process, as it was decided that it would be more appropriate for the user to see their username.

This gives confirmation that the user is logged in. It is worth noting that as a guest, you have most of the functionality that any other user would have. The only difference, is you can't see your sightings or log sightings. This gives an incentive to sign up for an account. You are also not able to upload community images. However, you can view the already uploaded images.

This is the PHP / MySQL code used to find the birds that are within 5 miles of the user (Fig 3). This code limits the results to only including sightings that have been logged in the last week. These limits have been put in place to ensure the information that is being returned is up to date and relevant.

```
$lat = $_POST['lat'];
$lon = $_POST['lon'];


$sql = "SELECT sighting.id_sighting, bird.name, image.images, sighting.creation_time, sighting.lat , sighting.lon, ( 3959 * acos( cos( radians($lat) ) * cos( radians( lat ) )
        * cos( radians( lon ) - radians($lon) ) + sin( radians($lat) ) * sin(radians(lat)) ) ) AS distance
        FROM sighting
        INNER JOIN bird
        ON sighting.id_bird = bird.id_bird
        INNER JOIN image
        ON image.id_image = bird.id_image
        WHERE creation_time >= DATE(NOW()) - INTERVAL 7 DAY

        HAVING distance < 5
        ORDER BY distance

        ";
$result = $link->query($sql);
```

Figure 3: Query to determine distance

Whilst developing the Android application, there were some features that required a lot of thought process. For example, when developing the Nearby Birds feature, initially the sightings were limited to be one of each species. This was then changed to allow for more than one sighting of each bird later, which takes flocking into account.

Another example of this is the "most likely to see" section. Initially, you would only be able to see one result. This would be the closest sighting to your current location, which wouldn't take date in to consideration. This could mean you are seeing information that is out of date. It could show that you are likely to see a bird 3 miles away, but it was seen four months ago. The problem with this, is a sighting could have been logged 3.1 miles away yesterday and it wouldn't be accepted as the most likely to see. To resolve this problem, you are now able to see the seven closest sightings. This gives you a higher probability of being able to find a relevant result.

5.3.5 Website

The website has been created using a combination of HTML, CSS, PHP, JavaScript, jQuery and Bootstrap. The website has been developed to allow a larger number of users to access the sighting information. On the website, the user can sign up for an account, view their sightings, view all the sightings on a map and view each of the birds in the database. There is also a page that tells the user about the Android application.

The recent sightings section of the “home” page uses a JavaScript function to refresh the page every 5 seconds. This is then stored in an iframe to show the user the most up to date sightings. There were a few issues encountered during the development of this function. This is due to the developer having no prior knowledge of web development languages including JavaScript.

The website was initially never part of the plan for this project. The website was conceived to allow Bird Buddy to reach a larger number of potential users. Whilst you can’t log sightings on the website, you are able to view the distribution of birds throughout the country and see each different sighting. This makes an account on the website a lot less important than if you are using the mobile application. Most of the functionality is shared for users with accounts and guests. The only difference is the ability to view your own sightings.

Session variables have been used to allow the user to sign in to the website. As with the Android application, there is the option to continue to the site without signing in. If you choose to continue as a guest, you will have the same functionality, except you won’t be able to view your sightings.

5.3.6 Security

Security is something that should be taken seriously in any instance. However, security aspects are costly. Attempts have been made to ensure that there are no risks in my systems. “mysqli_escape_string” has been used where possible to mitigate against MySQL attacks such as SQL injections on the website.

The passwords are hashed in the database when the user registers in to the system. There is a function in PHP called “sha1()”, which essentially salts the password within the database. The string that the user enters when they login is then salted to see if the strings match. If the strings do match, you will be logged in to the system.

In the future, an SSL certificate will be purchased for maximum security. A more secure way of storing user’s passwords in the database would also be addressed.

To create a user account, you must provide some personal information. The only personal information that is stored when creating an account is an email address. This prevents any information about the user being taken in the case of an attack.

6. LSEP Issues

Throughout the project, the developer has tried to take in to consideration any potential ethical / social issues. From the first week, the developer was aware that there may be some potential issues involved with the application that was intended to be created. At this point, I would like to state that throughout this project I have adhered to the University's ethics policies. These issues are as follows:

- Distribution / use of online image without sourcing or referencing intellectual property

To resolve this issue, the developer intended on taking individual images of each bird himself for use in the application. This was an ambitious task as he only had a handful of images of the birds already. The developer contacted external sources to find out if they would be able to provide images.

- The information that would be collected when using user accounts

To prevent this from being an issue, it was ensured that no personal information is stored within the application of server side. The only information that is required for initiation of an account is an email address, a username and a password. For security purposes, the passwords are hashed out in the database. SSL would be used if the project would be developed further. However, due to monetary constraints, these measures aren't accounted for at this stage. Whilst the developer recognises the need for a secure system, during this time the issue hasn't been addressed in full. It is worth noting that when an SSL certificate is purchased, there will be minimal changes to the android application. It would simply be a case of finding all the "HttpURLConnection" and replacing it with "HttpsURLConnection".

- Data protection act

This is like the record above. No unnecessary data will be kept without the user being aware. The data collected will be archived after a year to prevent the files becoming too large and the applications running too slowly. The archived information will be taken care of accordingly.

- Storing the location of user's devices

Whilst the location of the user will be constantly on, the location will only be recorded when logging new data entry points. This is to prevent any concerns that are associated with inappropriate logging of user data.

- User testing

To ensure the University's ethical rules were not broken when it comes to the research and user testing of a project, an ethics form was completed. This can be seen attached as

Appendix N. User testing has taken place on two occasions to ensure the functionality is as simplistic as intended. The results of the user testing have been attached as Appendix O.

7. Architecture

The developer has created various UML diagrams to explain the different tasks that are accessible by different users for the Android Application and the website. The database architecture was created by analysing the operations that will be performed by users of the Android Application. The only tables that are accessed by the user are the bird table and the sighting table. The user doesn't have access to updating or deleting the data. They do however, have access to creating and reading the data. It is worth noting that the user has a limited view to this data if they are not the user that created the sighting. This is to keep the user's location information as private as possible.

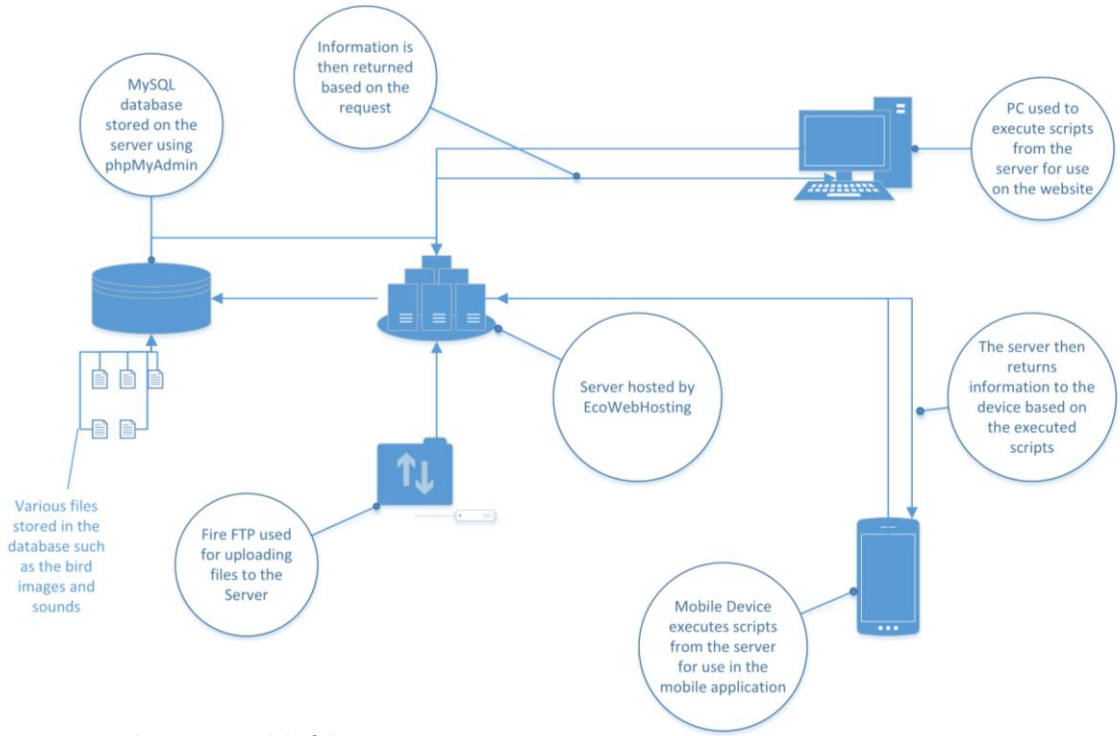

Figure 4: Architecture model of the service

This is a low-level architecture model of the way the application and website retrieve the information needed to run (Fig. 4). All the files are stored on the server. There is also an instance of a MySQL database on the server. This stores all the sightings, user information and birds in the system. There is a folder on the server that contains all the images and bird sounds. There is a table on the server which contains the URL of each image on the server for the website and application to make a reference to.

8. APIs used throughout / External Libraries

During this project, multiple APIs have been used. Below is a list of the different APIs used in my project and the significance it has brought.

- **Google Maps API (JavaScript):** This API has perhaps been the most important interface used in this project. It is used in the core website extensively. Without the use of this API, it wouldn't be possible to visualise the collected data.
- **Google Maps API (Android):** This API is the second most important interface used. This API is used in a similar fashion to the JavaScript counterpart. However, this aspect isn't as crucial in the Android Application.

External libraries have also been used in the development of the application and website. For more information about the libraries used, please look at Appendix P. Here is a brief list of all the libraries used.

- **Bootstrap 4.0 (Web):** Bootstrap is the framework that has been used for my website. It allows the website to be viewed on any device. Despite aiming to have the website only used on laptops / desktops, resizing is present.
- **GenAsync 1.2:** Allows for AsyncTasks with POST variables.
- **Gson 2.2.4:** Converts Java Objects to JSON representations.
- **KGJsonConverter:** Converts JSON to an array list.
- **Universal Image Loader**: An efficient way to load and store images in the Android application. This allows for caching of images for an easier work load on the application.
- **Fundapter:** This allows you to create your own adapters that will be used with ListViews. This adapter class allows you to use your own information in the lists.
- **Android-upload-service:** A library not in use. This would have been used for the uploading of images to the server.

9. Stages

9.1 Stage 1 Initiation & Requirement Analysis

Stage 1 focused on creating the necessary tools required for the development to come in the following weeks. During this time, a clear majority of time was spent researching in to potential hosting options. The developer also ensured that he would have access to all the tools that would be needed for the development of this project. This included the installation of PHP Storm, Android Studio, MySQL Workbench, NetBeans and GIT Bash.

During Stage 1, Pivotal Tracker was created and populated with relevant tasks for the first week. This is something that was updated regularly. As soon as a task was completed, it would be marked as completed on Pivotal Tracker. This time was used to Validate and Verify the requirements for the project based on the need for the features and how useful they would be to the users. This was backed up by a small anonymous survey created by the developer. The results to this survey can be seen in Appendix L. During this time, a BitBucket repository was initiated. Whilst no code was created this week, the foundations were created for the project.

9.2 Stage 2: Designs

Stage 2 was used as time to create the designs for the various tasks that would require a physical interface. During this time, the theme was selected that would be used throughout the whole topic based on information found on the material design website (Material design guidelines, 2017). An array of icons that would be used in the application upon completion were created. The developer was aware that Google have made material design logos available for download, however to create more of a personal feel, unique icons were created for the application.

In Stage 2, the initial designs were implemented in Android Studio and a prototype was created. After the completion of the prototype, the code was uploaded to the BitBucket repository system. The source code for the Android application can be accessed from the following link (Bitbucket.org, 2017).

https://bitbucket.org/dandrews95/birdbuddyandroid

During Stage 2, the developer found that he was slightly ahead of schedule. The designs were then enhanced in Android Studio and the database was looked in to for implementation in the following stage.

Most of these designs were used in the final product. However, a few minor adjustments to the interface were made to the application based on the user testing done later in the project.

9.3 Stage 3: Database

In Stage 3, several types of potential database options that would be available to store the information about the birds and storing the sighting information were looked in to. A MySQL database was selected for this project. The reasoning for this can be found in Appendix R. The data about each species of bird that would be used in the database was collected at this point. At this stage, there were 31 birds in the database. This would then be extended at a later date.

An initial implementation of the existing database was configured on AWS in preparation for the creation of the Middleware, to access the relevant information in the Android application and the website. At this stage, a very basic version of the website was also created. For this, the interface was the main focus based on the designs that were created in the previous stage.

It was noticed that there was a lot of time for the completion of this task. However, realistically the database didn't take the three weeks that was anticipated. After completion in a single week, a supervisor meeting was called upon to express concerns with the initial plan. The supervisor gave assurance that this is nothing to worry about, however it should be mentioned in this report.

Stage 3 was also used to start the write up of this report. It was understood that this would be a large task to tackle and treated it as such. For this reason, small chunks of the report were created throughout the development process. This allowed for contingency time at the end of the project to review the report and make improvements based on the progress made. Insight was gained from the supervisor about the current reports structure and what it should contain.

During this stage, there was a realisation that too much work was being taken on at once. The focus had been on the whole project instead of focusing on the current stage. This was realised when working on setting up the Web Server; a task that shouldn't have been completed until Stage 6 at the earliest. After this realisation, a decision was made to stick more rigorously to the plan. If there was more time to go at the end of the stage, the developer would start to work on the next stage and the next stage only.

9.4 Stage 4: Middleware & Integration

Stage 4 was meant for the development of the Middleware between the database and the Android Application. The purpose of completing the integration this early, was to allow for the logging of data from an early stage. This would then allow the website to be developed with live data in the system. Unfortunately, in this stage the possibility of changing web hosting was looked in to. This was due to being unhappy with AWS and the expected costs. AWS only offers the minimum requirements for a server to be free. The usage is very low, which would incur additional costs. As the development of the middleware was initiated at an early stage, the costs would constantly increase throughout the project. For this reason, different web hosting options were looked in to.

EcoWebHosting was then selected for hosting. You can see the reasons for this change in Appendix Q. Unfortunately, the server side supported languages for EcoWebHosting were overlooked. This meant the server didn't support server side Java code. This left me with two options: search for a third hosting company, or program the middleware in PHP. As a week had already been lost at this point, the decision was made to stick with EcoWebHosting and focus on programming the middleware in PHP. As PHP would be used for the website anyway, this wasn't seen as being too big of an issue.

It is worth noting that the server side scripts have been created in a way that they would work cross platform. This would allow for the creation of an iOS port, with minimal changes as the functionality will mostly be the same, and the scripts wouldn't need changing at all.

Instead of focusing on the implementation of the Middleware, in the first week, the focus was setting up a basic website. This allowed me to get to grips with the different languages that would be using during the Web Development, including PHP. Whilst this was a minor setback, this development is something that would benefit the project in the long run. This allowed me to fully focus on user testing in Stage 6 instead of worrying about getting an additional service up and running. During the first week, basic website functionality was created. This included an implementation of the Google Maps API, and a functional login and register system. Using these skills that have been developed, a better understanding of programming in PHP was established.

During the second week of this increment, the focus was on the implementation of a fully functional website. This included the login and registration system that was created in the previous week. My idea for this week was to get a functional website so when the middleware is created, it can be integrated with the website and the Android Application at the same time.

An additional week was used during this stage. The necessary documentation was created for this and can be seen as Appendix D. During this week, the necessary scripts for the Android Application and Website were developed. Most of the scripts were similar, as much of the functionality is shared between both applications. However, in each instance

the code was changed slightly where necessary. This time was also used to begin implementing the scripts in to the Application and the Website. It was much easier to integrate the scripts with the website than in to the Android Application. By the end of this stage, work on the functionality in the Android Application was initiated, which is work that should have been started in the next Stage.

This took longer than anticipated for a few reasons. The first reason was unfamiliarity with the language. The second reason was due to a loss of focus on the task. This was a consequence of learning a new language, which was an overbearing time. Fortunately, during this time, the developer decided to work on other aspects of the project. This meant that whilst this stage would take slightly longer than anticipated, he was still being proactive. This involved completion of user testing documentation. An ethics form for approval was submitted during this time. By sorting out the Ethics approval form early on, there would be no time waiting around for approval before completing user testing.

After taking a slight change to the plan during this stage, the Middleware was developed in PHP. This was started by creating multiple scripts pulling various information from the database that would be necessary for the final website.

9.5 Stage 5: Core Functionality Android

In Stage 5, the functionality of the Android Application was worked on extensively. This stage started by using the PHP scripts created in the previous Stage. These scripts were used to create the ListView implemented in the Library section of my application. This was done by converting the Array to JSON using an external library. For a full list of the libraries used throughout this project, please see Appendix P.

Using this converter, it was possible to create the necessary JSON arrays for the sightings and nearby birds. This was all completed in the first week of this stage. During this week, the caching of the images in the database to the application was enabled. This would allow for offline access to the library and sightings. Whilst this isn't an up-to-date system, it does allow the user to view more information than if the images weren't cached. This would give the users the opportunity to use the application in areas with no service. This hasn't yet been implemented but the structure is there.

During the second week of this stage the rest of the Android functionality was the core focus. This involved finishing the sighting information and working with the Google Maps API in Java. After completing this, the functionality was then moved across to the website.

At the end of this stage, most of the necessary development was completed for the Website and the Android Application. The Application is currently at a level where feedback would be beneficial. It was estimated that the actual feedback will take a week, the remaining time will be used to make the changes requested by users.

The functionality that has been created in this stage is as follows:

- Viewing the birds in the library.
- Viewing in-depth information about each bird.
- Log your own sightings using POST variables (id_user, id_bird, lat, lon). The latitude and longitude are received from the users last known location.
- View your own sightings in a ListView.
- View the information about each of the sightings in-depth, including the location on a Google Maps instance.

9.6 Stage 6: User Testing & Website Development

To ensure that user testing would be possible and beneficial to the project, the necessary documentation was completed during week 5. In this time, an ethical approval form (Appendix N) was filled out. This included the user testing questions (Appendix S) and the consent form for the users to be able to opt out of the testing (Appendix T). The testing questions selected were beneficial to help understand how users would interact with the application.

The questions selected, allowed me to ensure the required functionality was there and working. This process was key for finding potential flaws in my system. As the questions for the testing were created before the functionality, the functionality was then developed to be based around the testing questions. This allowed me to ensure the functionality was being created correctly.

This stage was primarily based on getting user feedback for my project work so far. By completing the user testing at the beginning of April, there would still be time to make improvements to the systems before the deadline.

The beginning of the stage started with some server issues. The company decided they would migrate their hosts for overall improvements to their systems. This unfortunate incident halted production for almost a week. During this time, making any changes to the files on the server was not possible. This meant that no functionality would be developed on the website or the Android application during this time.

This time was used to focus on improvements to the Android application's functionality that was already in place. This largely focused on removing bugs and ensuring the application ran as smoothly as possible. This time was also used to create the project management documentation for the project. This involved creating the user guides (Appendix A and Appendix B) for my applications and creating the poster that would be used for the project showcase. The poster can be seen as Appendix V.

9.7 Stage 7: Evaluation & Final Testing

This is the last stage that required any development. In this stage, changes were made based on the results of the user testing period. The changes that were requested were all taken on board. Not all the suggestions were implemented. However, the largest change was the addition of some context to pages that weren't as clear as possible. For example, on the "Nearby" tab, the user would have no way of learning that they are seeing all the sightings made within the last week in a five-mile radius of their current location.

After these changes were made, there was still time to continue the development process further. During the remaining time of this stage, the functionality in the Android application doubled. You are now able to view your own personal sighting map, view sightings by time of year for each bird and you can search for various locations and see the sightings in the surrounding area. A document was created and attached as Appendix X that documents the functionality in the application and why it is there.

9.8 Stage 8: Report

The report was initially going to be completed at the end of development. However, it was decided early on that it would make more sense to update the report throughout the duration of the project. This was discussed with my supervisor and he agreed that it would be an excellent idea to get a head start on the report.

For this reason, most of the report was created during the development process. This allowed for constant notes of what had been completed each week. At the end of each stage, the report was updated with additional information about the project.

When the core functionality was complete, there was time left to work back through the report and update the information so that it was up-to-date and accurate. This has been very beneficial for there have been no concerns about writing the report at the end of the project. Tackling the report in small chunks has been very beneficial to the completion of this project.

As most of the report had been completed by this stage, final changes to the report were made before submission as a draft.

10. Deliverables

- Android Application.
- Website.
- Full source code available on BitBucket and CD attached.
- A poster for advertisement purposes / project showcase.
- Project Initiation Document.
- This Report.
- Video presentation of Android functinoality.

11. Project Evaluations

11.1 End Project Report

Throughout the duration of this project, a lot of changes have been made. For a change to take place, the possible outcomes were evaluated using risk management techniques. Below, you will see the changes that have been made to the initial plan throughout the development process.

- Changes from Plan

As previously mentioned, there have been a lot of alterations to this project from the initial proposal. These changes have been addressed in a suitable manner and the changes are justifiable based on the market research undertaken by the developer. The developer created a Gantt chart a few weeks in to the development process. This had an updated model of the plan to follow for guidance. These changes were carefully evaluated and the developer ensured that there would still be some contingency timing in case any issues were to arise. Some of this time was used whilst working on the Middleware, however, this was the only period where the contingency time was needed.

- Changes from PID

It was clear from an early stage that the plan created was not going to be as accurate as anticipated. This was discussed with the supervisor, who suggested it is because of the developer never completing such a task beforehand. This is due to estimation skills that are lacking from poor experience. This is something that will be addressed in the future as it is only possible to improve upon through more experience.

- Changes throughout

The first major change that has taken place throughout this project was the change from AWS to EcoWebHosting. This was a change that the developer made early in the process, due to the limits that AWS have in place in terms of hardware capabilities. The developer was also worried about the cost implications that come with AWS after you reach their

limits. This is something that is likely to happen early on. The initial plan was to program the middleware in Java. However, the new server didn't support Java. This set the developer back a week. For this reason, an exception report was created. This report can be seen as Appendix D.

11.2 Project Post Mortem

One thing that would be changed if the project was undertaken again would be the use of a client. This is something that would have benefited the requirement elicitation process. The product is based off requirements that have been selected to suit the end user's needs.

The management techniques employed have been crucial to the success of this project. Through use of Agile and PRINCE2 respectively, it has been possible to alter the requirements where necessary (Agile) and then document my reasoning for these changes (PRINCE2).

My user testing was a success and feedback was received about the systems developed. The received feedback varied depending on the background of the user. However, by thinking in advance, an Ethical Approval form was submitted weeks before it would be needed. This allowed me to have the clearance to do user testing whenever necessary. This also allowed me to develop the applications with the user testing questions in mind, this in turn led to a greater project.

I feel like my progression through this project has been the factor that has ultimately led to the project turning out the way it has. The project was started with a clear vision. As I have had the idea for a while, I started pinning down my ideas before Semester two started, which allowed me to get some of the necessary work out of the way before initiating the project. When semester two started, I got straight in to the development of all the necessary documentation and developed working prototypes in the first few weeks. This made me want to stay at this standard for the duration of the project. Unfortunately, I had a two-week period where motivation and productivity was very inefficient. This happened after I realised there was an issue with the Middleware. To try and keep proactive, I started to work on the website, which prolonged the work I would need to complete on the middleware. This was a way of trying to ignore the problem and I wouldn't recommend it. Fortunately, after this small period where my productivity slipped, I realised that I was beginning to fall behind. For this reason, I picked up the slack and started to work even longer hours on the project. This can be seen in my plan attached as Appendix M.

Having an idea that interested me has also been crucial to the success of this project. Something else that has enabled me to stay on top of things was the development of the report throughout the project instead of leaving it to the end. This is something that I found was crucial to the success of this project. By updating my report as I went along, I have been able to keep track of everything that I have been doing throughout. Whilst there has

been a lot of work on the report that I have taken out, it has been crucial for remembering everything that has happened throughout this project. It has also been a lot less daunting writing 1,000 words a week instead of 11,000 at the end of the development. This has also allowed me to make suitable changes early on and get beneficial feedback from my supervisor where necessary.

Throughout this project, I have used multiple development platforms. This has changed from the initiation of the PID. Initially, it was my intention to use NetBeans for the development of the Middleware, which then changed to PHP Storm when AWS was changed for EcoWebHosting. Whilst I would be able to use NetBeans for PHP programming, I felt that PHP Storm is better suited for my needs. I also changed the use of MySQL Workbench to phpMyAdmin for the database development, which was due to the integration with my server. The initial database work was exported to phpMyAdmin when the server was changed.

My passion for learning new skills has been beneficial during this project and I have spent a lot of time working on all aspects. At the beginning, I didn't want to let the project management aspects of this project suffer. For this reason, I spent a lot of time developing miscellaneous deliverables to support the design process and necessary changes. I have done so to fully document the processes that I have been through during this project and to clearly show why I have made the decisions that I have made.

11.3 Objective Evaluations

At the beginning of this project, objectives were set out for completion throughout the project. They have been evaluated below:

- My first objective was to be able to analyse existing systems used by bird watchers. This was to understand the importance of these systems and understand what users would be expecting from my application. I feel like this requirement has been met to a suitable level. I have analysed seven existing systems from the Google Play Store and Apple App Store to gain ideas for my layout and evaluate the decisions made. This can be seen as Appendix W.
- Users can log their own data entry points, which was a crucial requirement for me. From the word go, my idea was that users can only log data from the mobile application. For this reason, you are unable to log sightings on the website.
- The second crucial part of the application was to be able to see information that may help you to classify birds throughout the country. This is something that I completed by researching a lot in to the individual birds and finding attributes that would differ between the birds. These ended up being: size, image and habitat. Whilst I could have added other attributes such as colour or beak type, too much information may lead to complications. I have been able to create a list of these birds and provide the necessary information that a user may require.

- The final objective was to allow users to visualise the distribution of the data points. I have been able to do this by giving the user the ability to view the last logged data entry point for each bird, see where they will most likely observe a bird around them and to view all data points from the website. I feel like this has been a very successful objective as the visualisation aspects have been crucial for this project. This would not be possible without the use of the Google Maps API.
- After completing the core deliverables, I focused on creating more functionality that would be beneficial to the application. This included creating a habitat section in the Navigation Drawer. This allows the user to search for birds based on the habitat that they usually live in.
- Before I decided I would make a sighting based application, my first idea was to have an application that helps users to identify birds. After talking to potential users, I discovered that most users would already know how to identify birds. For this reason, I decided to change my idea to accommodate for the logging of sightings for birds instead of identifying them. After I finished all my core deliverables, I decided to add a feature that would allow users that may not know how to identify birds. The “What did I see?” section in the application, allows users to break down birds in to varied sizes. This allows you to search the library for birds that are within the size limits of each section.

12. Conclusions

12.1 Lessons Learnt

This project has been a learning experience for me and has given me the ability to expand on a lot of skills taught at university over the past four years. These include, but are not limited to:

- **Problem solving:** As I have been dealing with new technologies, there has been a lot of learning involved. This has meant that I have spent a lot of time learning new programming languages such as PHP, and learning the configuration of Web Services through AWS (despite abandoning this later).
- **Time Management:** Over the cause of semester two, I aimed to strictly follow a plan telling me how much time I should be spending on my project each day. This can be seen attached as Appendix T. These time management skills helped me to develop an understanding of what was expected of me during each week. There were two weeks where I had not stuck to my timings. Other than that, each weeks' time scales were met.
- **Project Management:** This project has involved a lot of project management skills. These are skills that I have learnt and developed over the past four years at university. Having a great aspect of management throughout this project has been crucial to the delivery of the products that I have created. Through careful planning and prototyping, I could see exactly what I needed to create at an early stage.
- **Risk Management:** Throughout this project, taking risks in to consideration has been vital for the completion of this project. Without fully taking these risks in to consideration, the outcome of this project could have been completely different. A key example of this would be changing my hosting from AWS to EcoWebHosting. This was a decision that was difficult for me to make and I had to balance the risks before any changes were made.
- **Web development:** I have learnt a lot about web development during this project. Web development is something that has been completely new to me as I have never had the opportunity to do so before. During this project, I have used new languages to me, including: HTML, CSS and PHP.
- **Server Side language:** I have learnt how to use PHP and manipulate MYSQL to JSON encode and return different results. This has been beneficial for the development of the Android Application as most of the functionality is based around POST variables in PHP.

12.2 Further Development

This has been an interesting project that I have found to be very beneficial in developing my skills as a programmer. Should I continue this project, there are a lot of changes that would need to be made before launching the application. Firstly, the application would need to have each different bird from the UK stored in the database. Currently, there are 51 birds in the application. There are 597 different birds available to see in the wild throughout the UK. This would be a big feat as I would have to find an image for each different bird.

Nearing the end of my project, I thought about various cross platform integration plans. This included an android wear application and a Samsung edge application. This is something that I will continue to look in to. Whilst thinking about the scripts I have created, I believe it could be a good idea to create an iOS application based on the scripts I have created.

The List Views within the Android application will be replaced with Recycler Views. This is something that will improve the efficiency of the application. Currently, this isn't an issue as the images are cached within the system. This change would be beneficial to the Library system. Loading 51 different objects in a list is not an issue. If there were 600 birds in the system, loading the Library would take a lot longer to execute. Using Recycler Views would prevent this from being an issue as the only objects that are being loaded are the ones that are on the screen at any given time.

For the duration of this project, having only one image per bird has been acceptable. In the future, having more than one image per bird would be looked in to. This would be done to include one image for a male version of the bird and one image for the female version. On top of this, an image for winter coats may be introduced where necessary. This wasn't included in the application as finding a way to show multiple images would potentially over complicate the design.

I am aware that there is still work that needs to be done on the application. This falls to the fact that an Android application can never be complete. Most applications have regular updates.

For a list of all the resources that have been used throughout the project development, there is an attached list at the end of this report as Appendix Y.

12.3 Final Thoughts

This project has been a challenge for me. Throughout the development process, there were multiple issues, such as the incompatible middleware to server. These issues were all overcome as stated throughout this report. This project has been crucial for my understanding of software projects. Unfortunately, throughout the development process I haven't had a real client. If I did have a client, I would have gained an even greater understanding of the project lifecycle.

I also had issues when collecting the sighting information. This was a problem for me as I wanted to have sufficient data for various times of the year and 51 distinct species of birds. These issues were overcome throughout the duration of this project. When I was completing my user testing, I also took this time to log data of my own in copious quantities. To keep the data as realistic as possible, I took multiple walks in the countryside to see if I could spot various birds and logged the information when seen. It is worth noting that for some of the birds such as the Golden Eagle, the data was implemented incorrectly. As Golden Eagles are only found in Scotland in the UK, I would have great difficulties finding one in Devon / Somerset. An additional application called "Fake GPS" has been used to log these sightings.

My final solution was an active web application that can be accessed by any member of the public, and an Android application that can be used to log sightings and view sighting distributions. However, currently you are only able to see the information about 51 species of birds instead of the 597 birds in the UK. Should the project be continued, this is the first thing that will be addressed. There is also the potential to log information offline. With additional research and tweaking of functionality, I believe this is a product that would be able to be released to the Google Play store and would be beneficial to a lot of people in the bird watching community.

Word Count: 10,996

13. References

Below is a list of the sites that have been used for the development of the Applications and the development of this report. You will find more references within my Appendices where necessary.

1. Bitbucket.org. (2017). *Bitbucket.* [online] Available at: https://bitbucket.org/dandrews95/birdbuddyandroid [Accessed 02 February 2017]
2. Material design guidelines. (2017). *Color – Style – Material design guidelines.* [online] Available at: https://material.io/guidelines/style/color.html [Accessed 02 February 2017]
3. The RSPB. (2006). *Birdwatchers' code.* [online] Available at: https://www.rspb.org.uk/birds-and-wildlife/read-and-learn/watching-birds/code/index.aspx [Accessed 16 May 2017]
4. GitHub. (2017). *Amigold/Fundapter.* [online] Available at: https://github.com/amigold/FunDapter [Accessed 08 March 2017]
5. GitHub. (2017). *Nostra13/Android-Universal-Image-Loader.* [online] Available at: https://github.com/nostra13/Android-Universal-Image-Loader [Accessed 08 March 2017]
6. GitHub. (2017). *Kosalgeek/KGJsonConverter.* [online] Available at: https://github.com/kosalgeek/KGJsonConverter [Accessed 08 March 2017]
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10. Material design guidelines. (2017). *Introduction – Material design – Material design guidelines.* [online] Available at: https://material.io/guidelines/material-design/introduction.html [Accessed 02 February 2017]
11. EcoWebHosting. (2017). [online] Available at: http://ecowebhosting.co.uk [Accessed 03 March 2017]
12. GitHub. (2017). *gotev.* [online] Available at: https://github.com/gotev/android-upload-service/ [Accessed 18 May 2017]

Appendices:

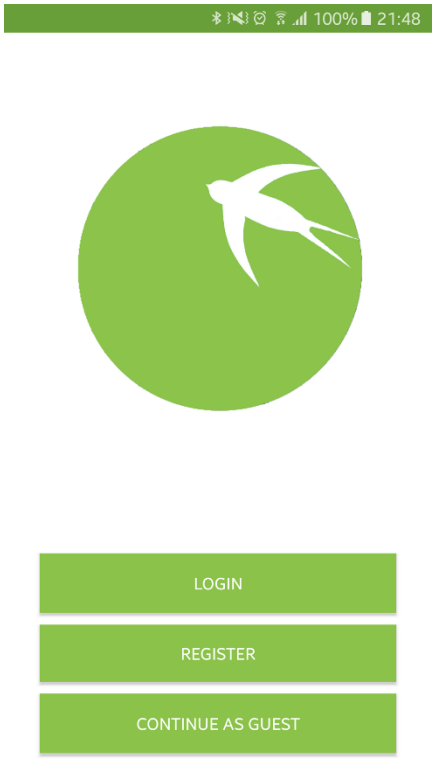
Appendix A: Android Application User Guide

1. Minimum Requirements
2. Main Screen
3. Login
4. Register
5. Continue as a guest
6. Logging a Sighting
7. Viewing your sightings
8. My Sighting Map
9. Navigation Drawer
10. Viewing Library
11. Searching Library
12. Viewing Bird information
13. Viewing Last Seen
14. Viewing Most Likely to see
15. Viewing All Sightings
16. Viewing Nearby Birds
17. Search by Location
18. Habitats
19. What did I see
20. What you can do as a guest

1. Minimum Requirements:

To run this application, you must have an Android device running at least Android Lollipop (5.0) or API 21. The Target API level is 23. You can run the application past this level too.

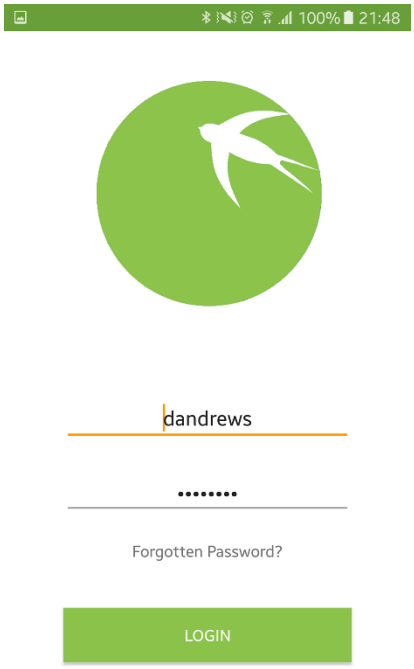
2. Main Screen:



The first time you launch Bird Buddy, you will be faced with the above screen. This screen gives you the ability to register as a user, sign in to your account, or continue as a guest. If you opt to continue as a guest, you will have most of the functionality that registered users have. This will be discussed in further detail later in the guide.

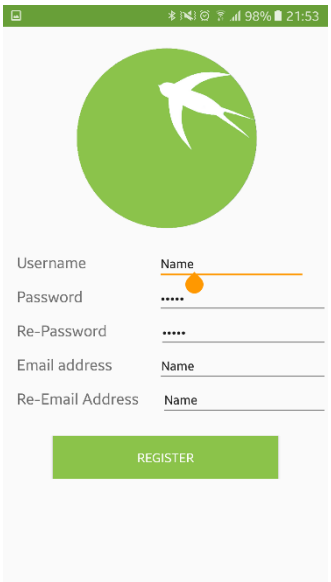
I will now discuss the login screen.

3. Login



If you already have an account, you can go straight to the login page. This is where you will enter your existing credentials to sign in to the application. There is the ability to press the forgotten password if you forget your password.

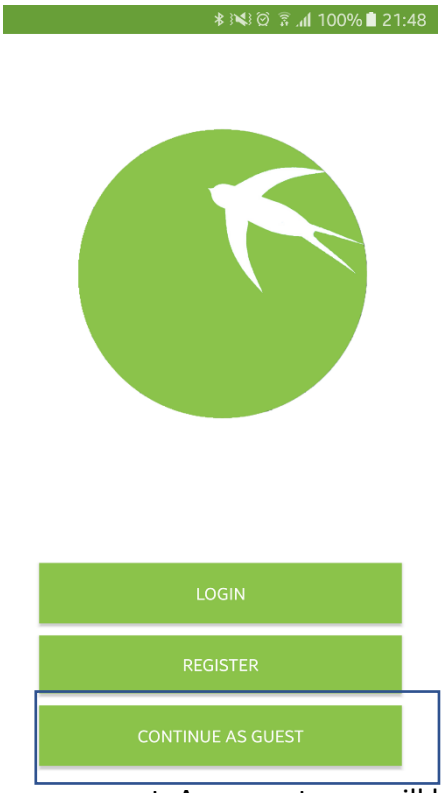
4. Register



If you don't have an account, to make the most out of your Bird Buddy experience, you can register as a user. This requires you to create your own username, a password and enter your email address. Bird Buddy doesn't collect any of your personal information. The only information that is required of you is the email address. This is for your personal

safety. To ensure that you don't enter the information incorrectly you must enter the password and email address twice.

5. Continue as a guest



The final option is to continue as a guest. As a guest, you will have all the functionality that you would have as a user, except you are not able to log your own sightings, or view your own sightings. (As you won't have any). Logging sightings is one of the key functionality points for Bird Buddy, so to make the most of this experience you should create an account.

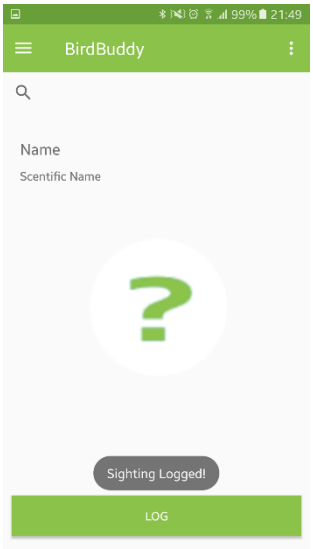
6. Logging a Sighting

After you have signed in to your account, the first screen you will see is the logging of a sighting screen. To log a sighting, you simply must press the search box, enter a bird's name, click on the bird, then press log.

For a sighting to be successful, you must have location services enabled, otherwise you may be unable to log your sighting.

This is the screen that you will see when you select a bird. You will get to see the name and scientific name of the bird. You can also see an image of the selected bird, this is to ensure that you have selected the correct bird.

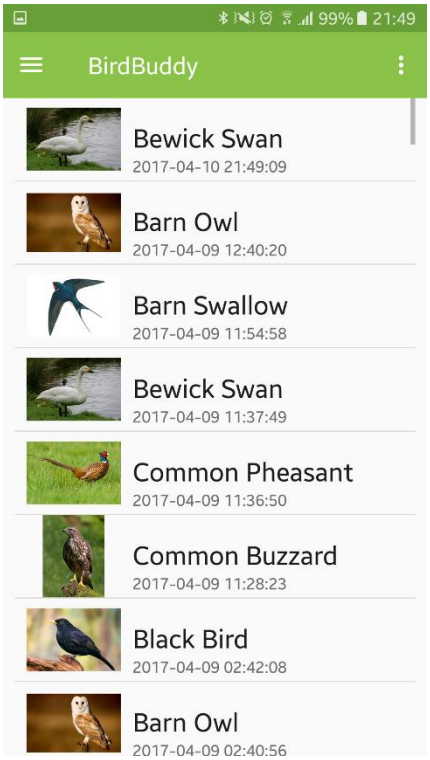
This also gives you the opportunity to make sure that the sighting you are logging is correct.



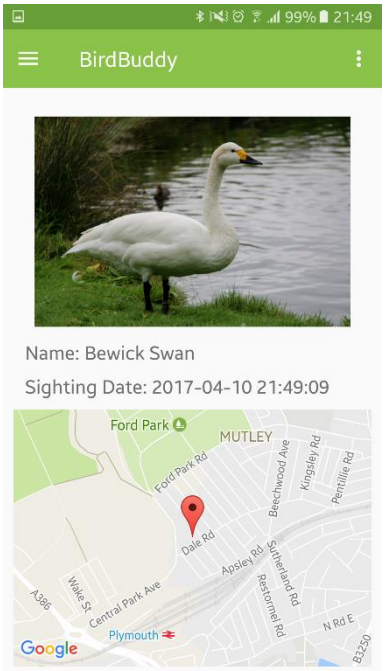
After you have logged the sighting, if it is successful you will receive a message at the bottom of the screen stating that the sighting has been logged and the screen will refresh.

If for any reason, you are unable to log a sighting, the screen will stay the same, but you will have a message telling you why you have been unable to log your sighting.

7. Viewing your sightings



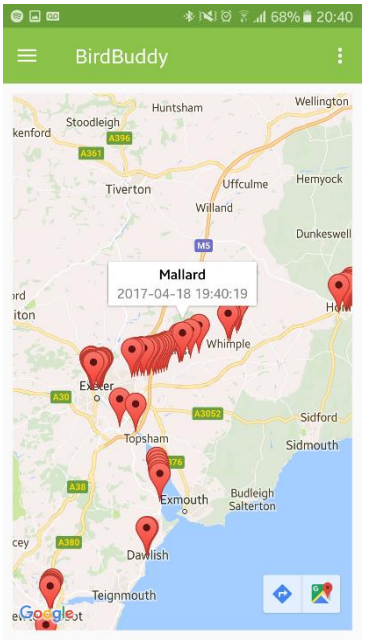
After you have logged a sighting, you can check to see if the sighting was successful by going to your sightings from the navigation drawer. As you can see, we are able to see all my recent sightings, and the time that you saw the bird.



If you click on any of the sightings, you will be able to see the location of your sighting. You can then zoom in or out to see the exact location.

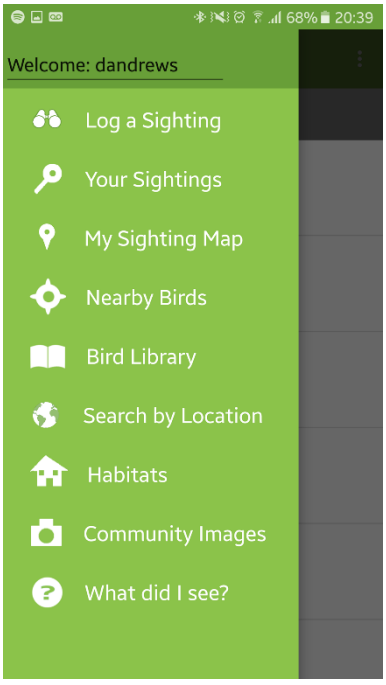
You can also see the image of the bird, the name and the sighting date and time. This is to allow you to retrieve the most information as possible from your experience.

8. My Sighting Map



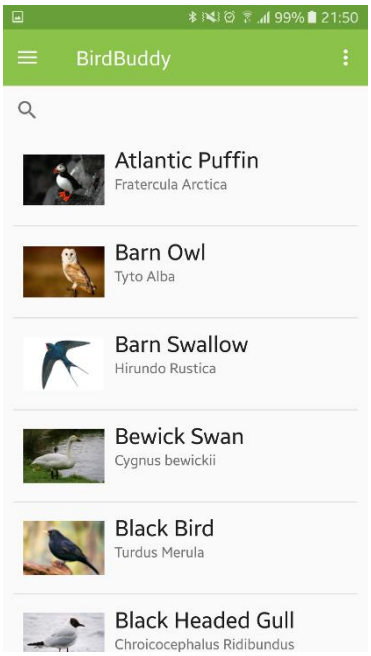
Alternatively. You are able to view your sightings on a map. This will show you each of your logged sightings as a marker. You are able to zoom in and out freely to get a good view of where you have been. To find out the meaning behind each of the markers, you can click on one of the markers and it will tell you the bird and when you logged the sighting.

9. Navigation Drawer



This is the navigation drawer. This is where you can see most of the unique features available within the Android application. As you can see, you have your username at the top of the page. This is a way for you to ensure you are signed in when you are on the go.

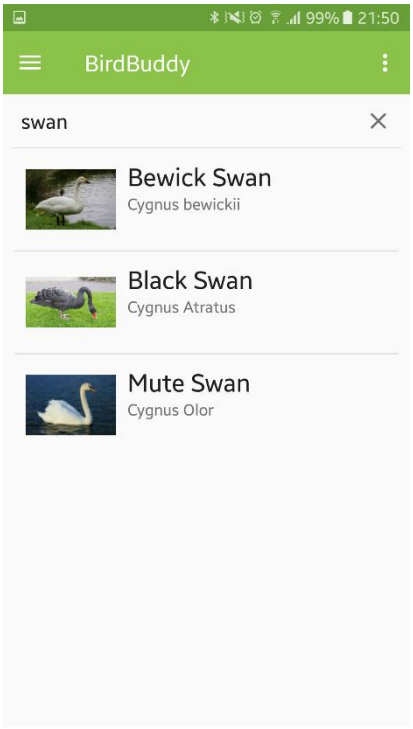
10. Viewing Library



When you click on the library, you will be able to select any of the birds within the system. You can see the name, scientific name and image of the bird. You will also notice that the birds are in alphabetical order.

11. Searching Library

To speed up this process, you can also use the search box. After each letter, a query will run to retrieve you the birds that have the series of letters in their name.



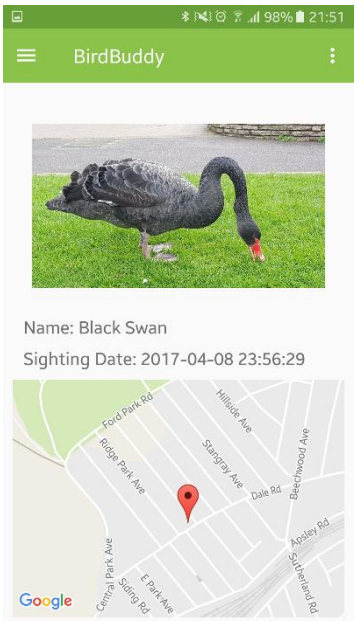
This is the screen that is available when you search for a swan. As you can see there are multiple swans in the system.

I will now show you what happens when you click on the Black Swan.

12. Viewing Bird information

There is an array of available information about the Black Swan available to you. You can see the average size, conservation status and a fact about the animal. If you then scroll down, you are also able to see where you are likely to see the bird. You will also notice that there are two buttons available. The first is to see where the bird was last seen, the second will take you to a screen that shows you where the bird was seen last closest to your location.

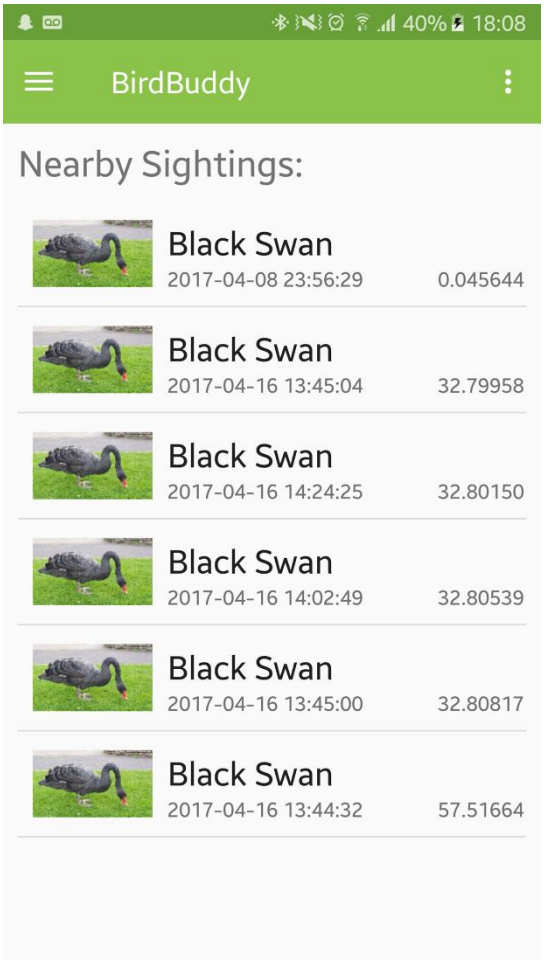
13. Viewing Last Seen

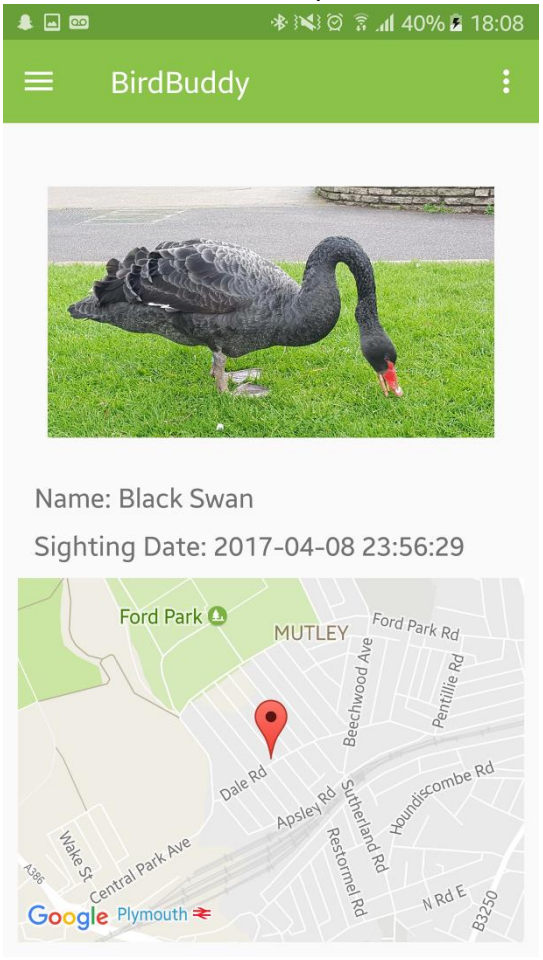


When you press the last seen button. You will be taken to the last place where the selected bird was seen, and the date and time that it was seen. This will not give you any information about the user that sighted the sighting for privacy reasons.

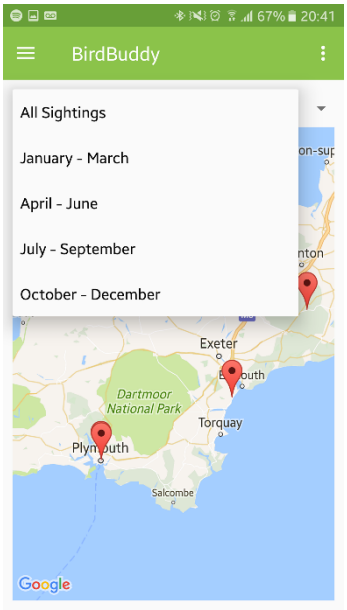
14. Viewing Most Likely to see

It is all well and good seeing where the bird was last seen, but what if the last location the bird was seen was 100 miles away? For this reason, there is a "most likely to see" section. This will show you the last time the bird was seen within a 5-mile radius of your location. To ensure this information is relevant and up to date.





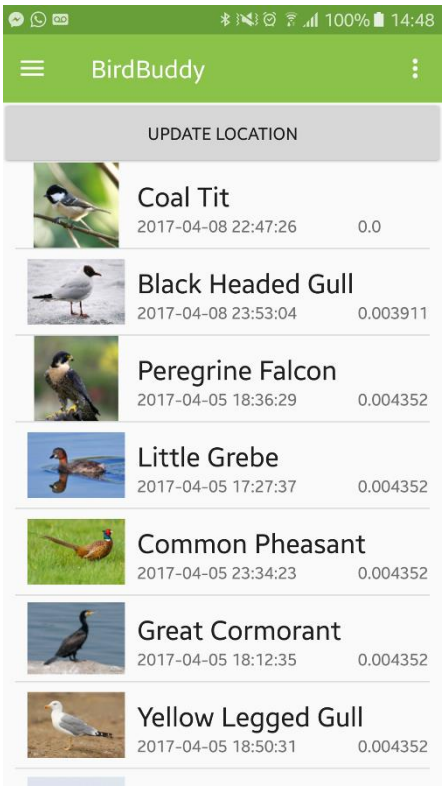
15. Viewing All Sightings

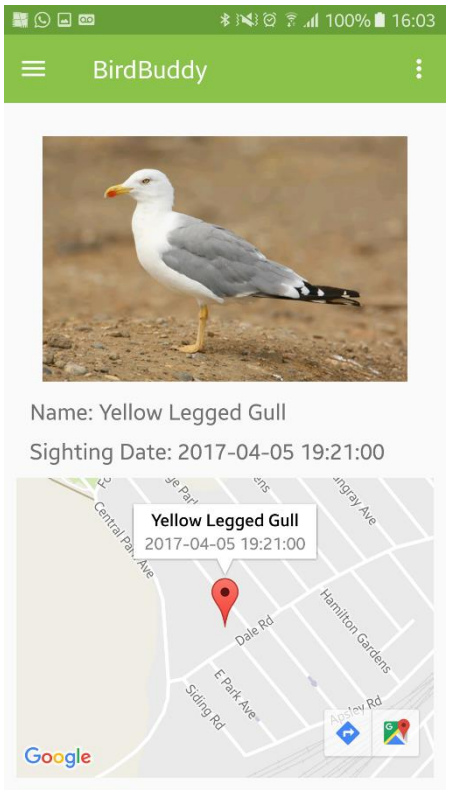


The third button on the bird information page will take you to a map with one marker for each of the sightings logged. You can then zoom in to see exactly where the sighting was logged. By clicking on one of the markers, you will be able to see the sighting time and date.

You can also change when you would like to see the sightings by time of year. This gives you a clearer indication of when and where you will be most likely to view the bird.

16. Viewing Nearby Birds

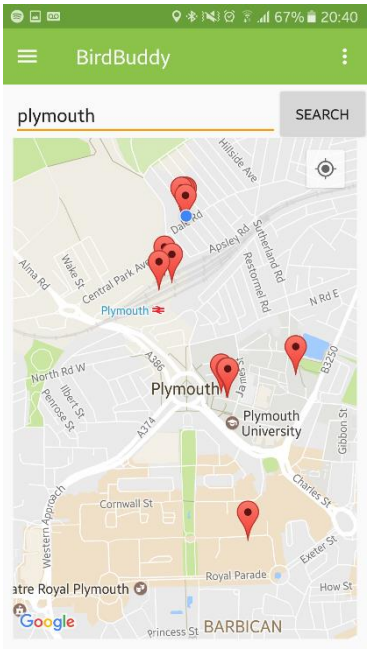




As with the most likely to see feature, the Nearby birds shows sightings within a 5-mile radius that have been logged within the last week. One problem with this, could be that a group of people all log the same sighting. To prevent your Nearby feed being clogged with seven instances of the same bird, you will only be shown distinct values. This means, if seven people log a sighting for the same bird, you will only be shown the closest bird to your location.

By pressing update location, you will be able to see how much closer you are to the sightings, or see new sightings.

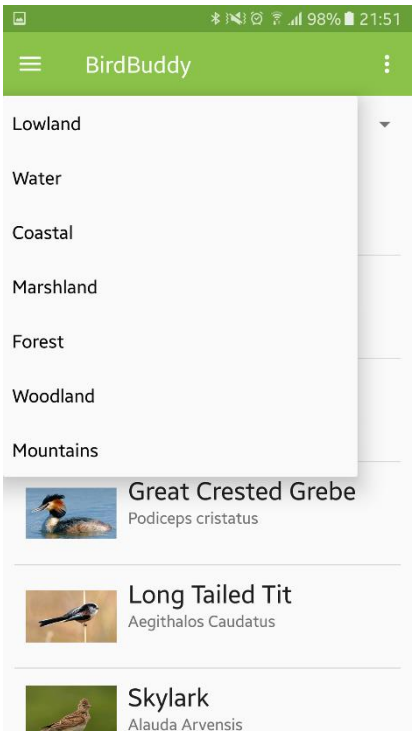
17. Search by location



If you are on a day trip and you want to know what birds have been logged where you are, you are able to search by location. Providing the location exists, you are able to view all of the sightings that have been logged in the last two weeks in that surrounding area on a map. By clicking on one of the pins, you will be able to get all of the information you need to see what you might find!

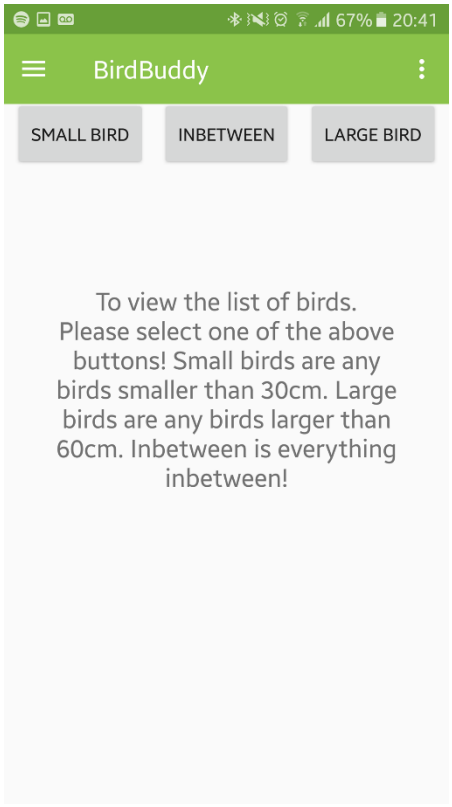
You will also notice that you can see your own location on this map, this can be used as an indicator for you to see how far away the birds are from your current location.

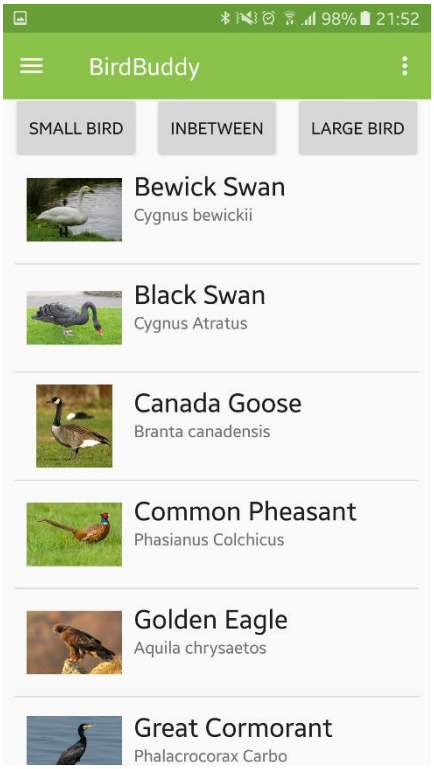
18. Habitats



If you know that you may be going to visit a forest later in the week, you may want to know what you are likely to see on your travels. For this reason, the habitat feature has been implemented. You can select your habitat from the list of 7 available in Bird Buddy, and you will be given a list of birds that are usually found in these areas. This doesn't mean you won't find some different birds on your travels, it is just a nice indicator of what you could see.

19. What did I see





Identification of birds can be difficult. There are almost 600 birds that can be seen throughout the year in the UK. Occasionally you may come across a bird that you can't identify. With this is mind, the What did I see section was created. Searching through the library when you don't know what you are looking for can be difficult. So, you have the option to break down what you have seen in to three sections.

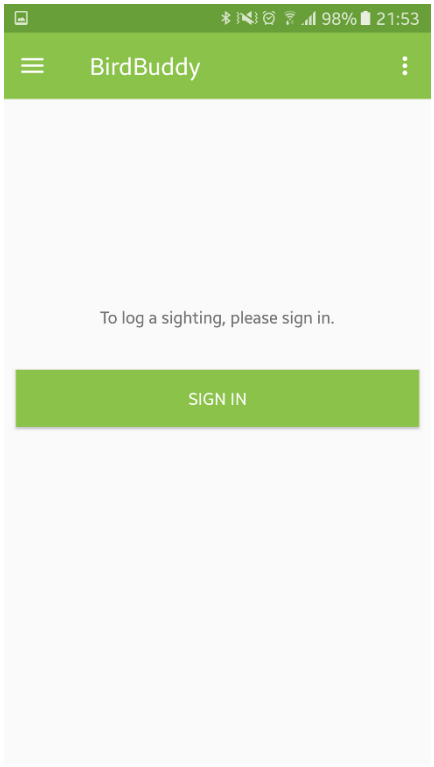
Small Birds: This will be any bird that is 30 cm or smaller

In-between: This will be any bird that is between 31 cm and 59 cm.

Large Birds: This will be any bird that is larger than 60 cm

This makes identifying what you have seen a lot easier as you are able to break down what you have seen by the rough size.

20. What you can do as a guest



As a guest, you will have all the above features except the ability to log sightings or view your own sightings. The only information that Bird Buddy collects from you is your email address, we never ask for any personal information, and nothing gets shared with other users. For this reason, signing up for an account with Bird Buddy is the best way to make the most out of this experience.

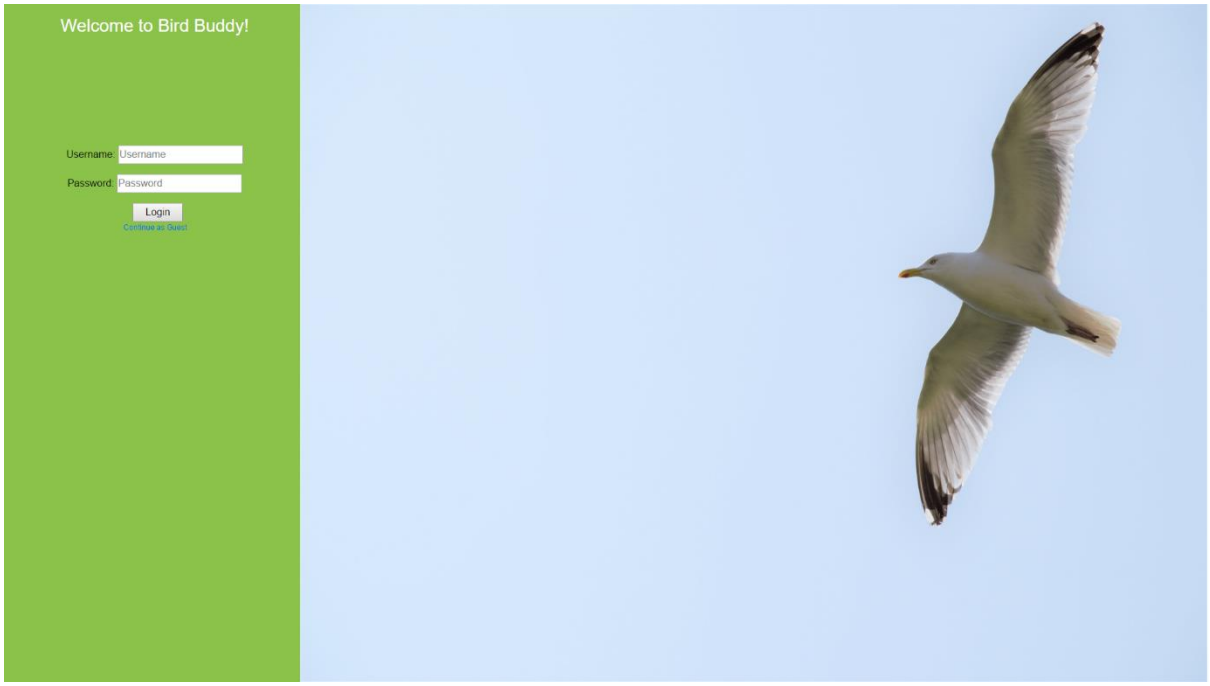
Appendix B: Website User Guide

Website User Guide

Welcome to Bird Buddy. This is the first screen that you will see when you enter the URL www.bird-buddy.co.uk

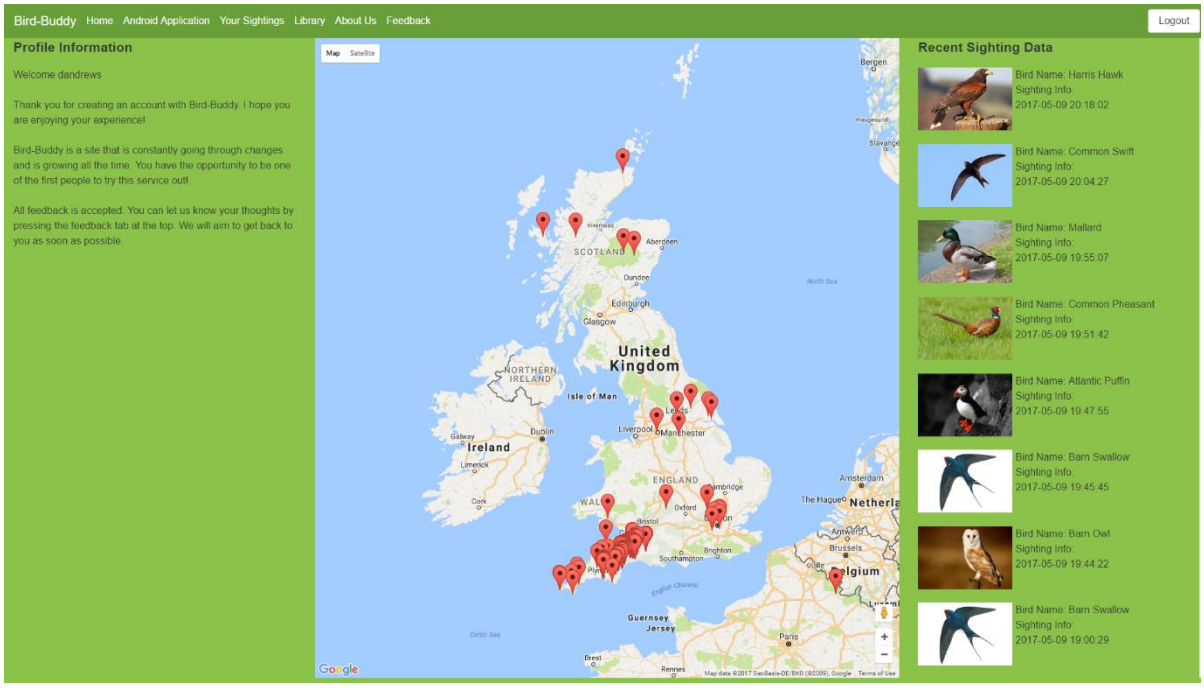
The website has been checked in Google Chrome (Version 57.0.2987.133 (64-bit)), Mozilla Firefox (version 53.0) and Microsoft Edge (Microsoft Edge 38.14393.1066.0).

From this page, you are able to either login to your account that you have created using the Android Application, or continue as a guest. As a guest, you have access to all of the functionality except the ability to view your own settings.

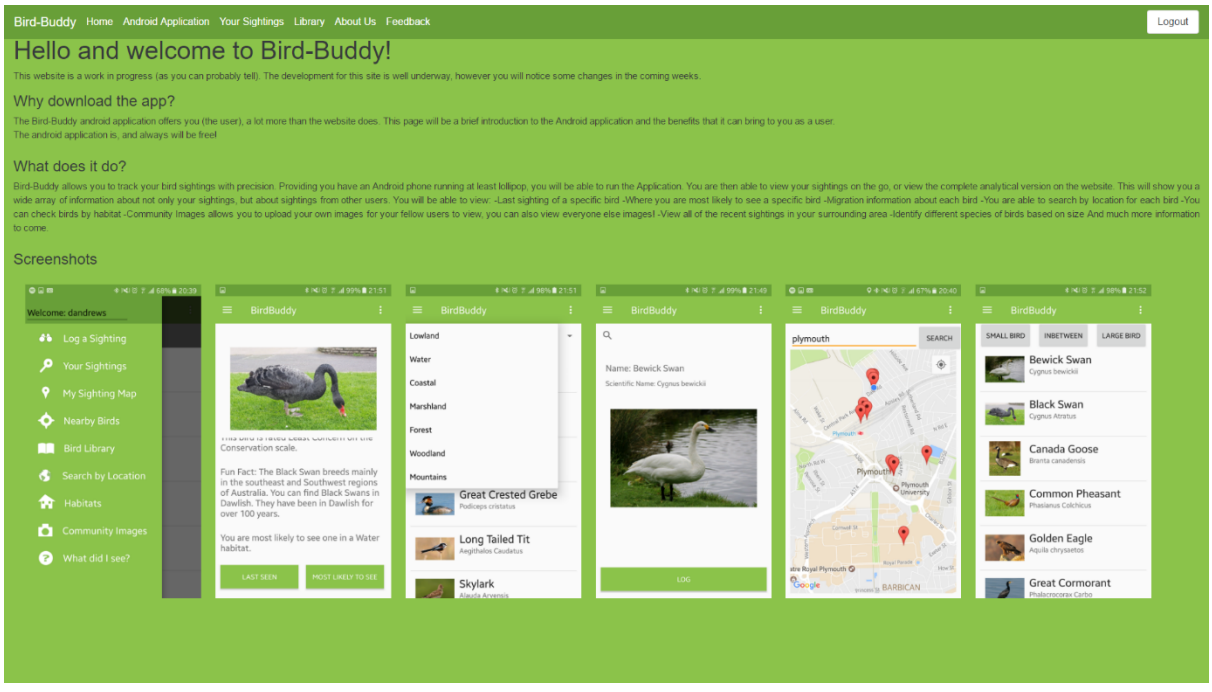


When you login, or continue as a guest, you are taken to this page. You can access this page by clicking on “Home” in the navigation menu.

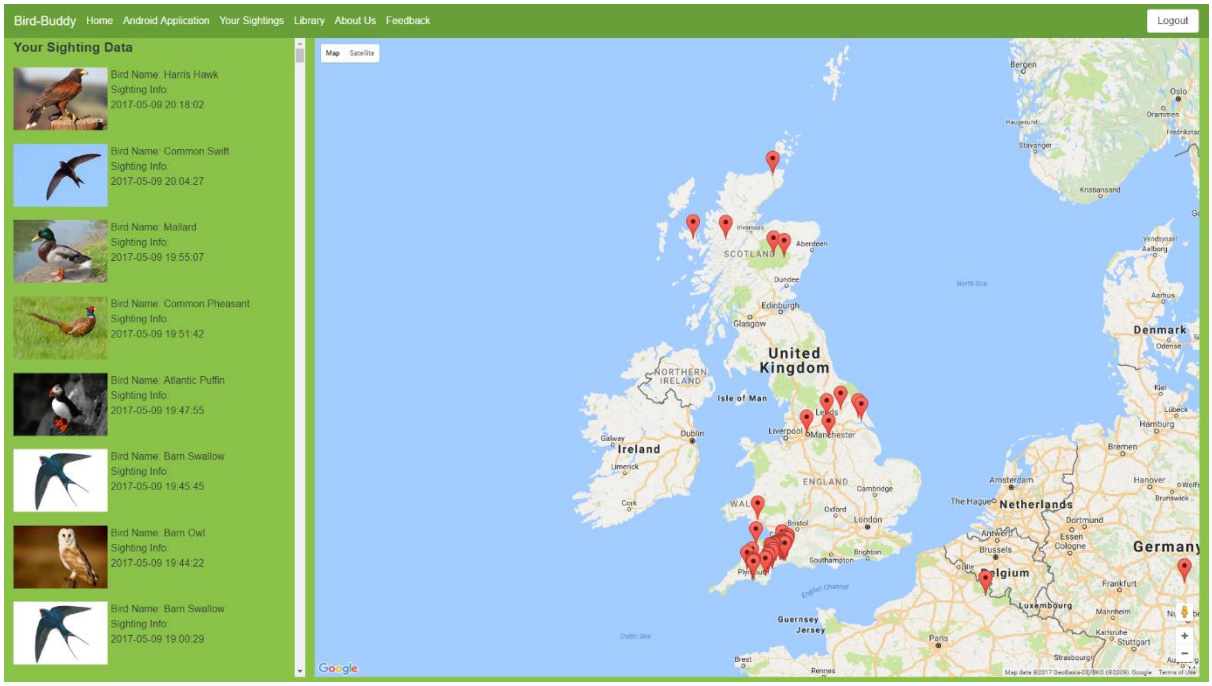
On the left-hand side, you will see your username. This is how you can ensure you are signed in to your account. On the google maps instance in the middle, you can see all of the sightings that have been logged. On the right-hand side, you will see all of the sightings that have been logged in the last week.



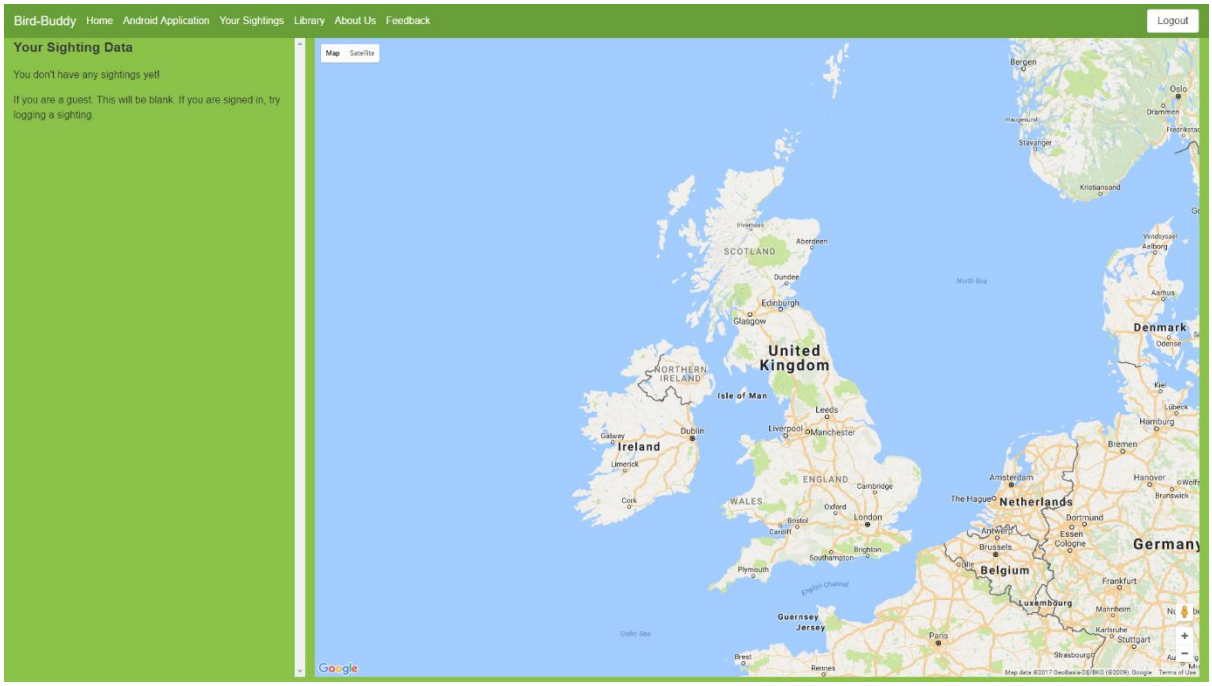
By clicking the Android Application tab on the Navigation menu, you will be able to see more information about the Android Application and what you can do when you are logged in. You can also see some screenshots of the application in use.



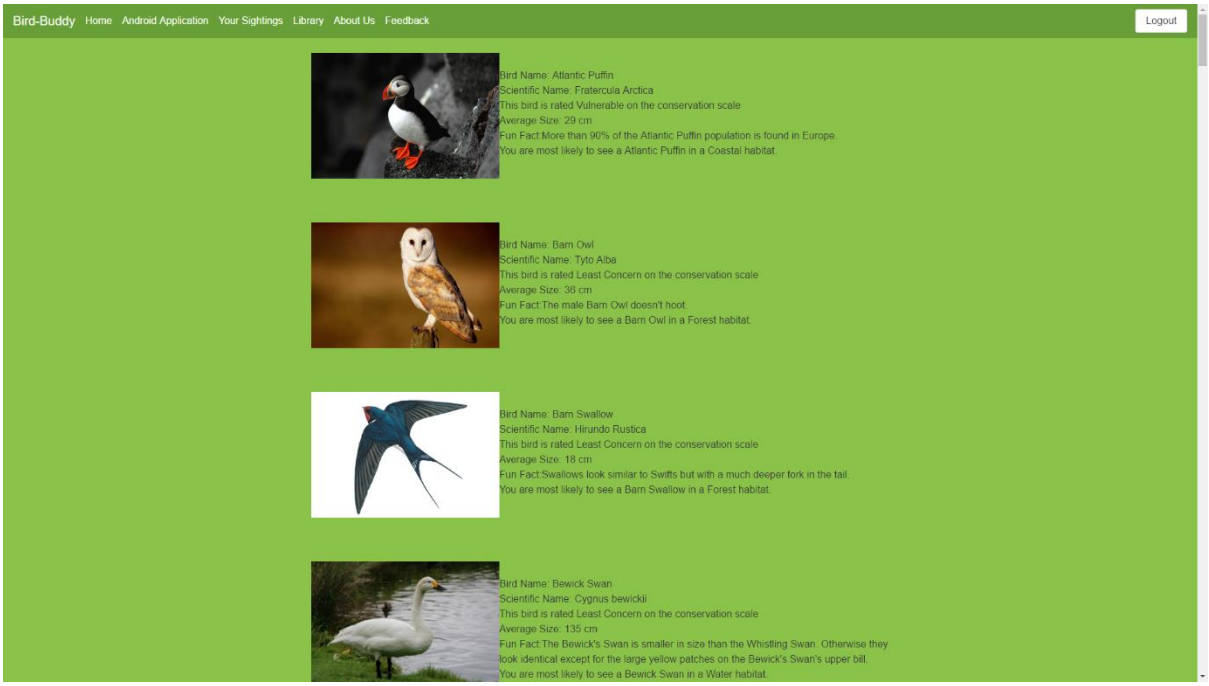
When you click on the “Your Sightings” tab at the top of the navigation menu, you can view a list of all of your sightings on the left hand side, and a google maps instance of all of these sightings on the right. By clicking on one of the markers, you can see the name of the sighting, and the



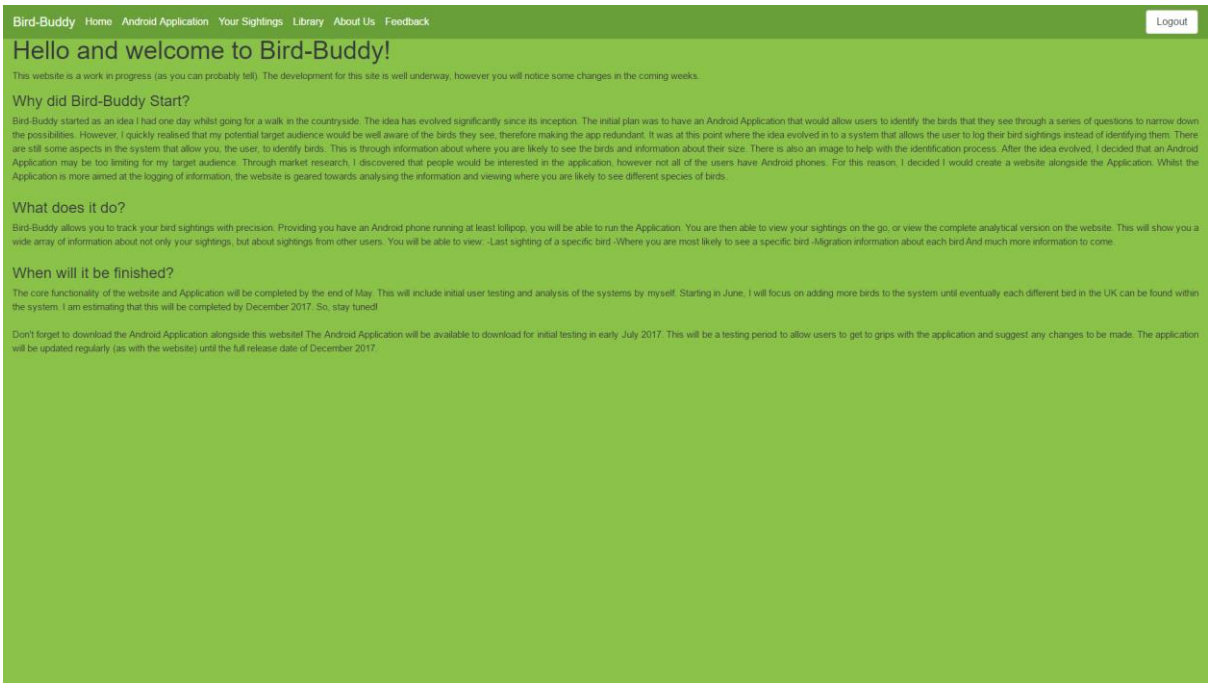
If you aren’t logged in to an account, or you haven’t logged any of your own sightings, you will instead see this page. It is exactly the same, except the message is different on the left.



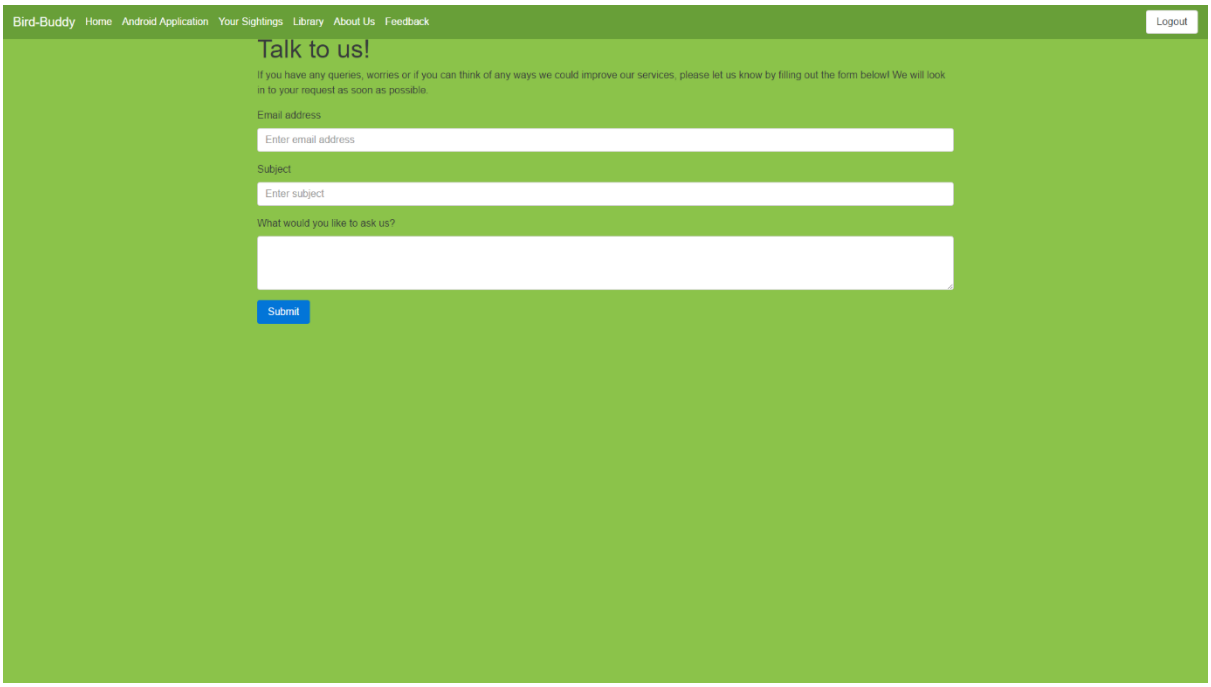
When you click on the “Library” tab, you are taken to a page that shows you a list of all of the birds in the database and information about each of the birds. This is the same information that you would see on the Android Application.



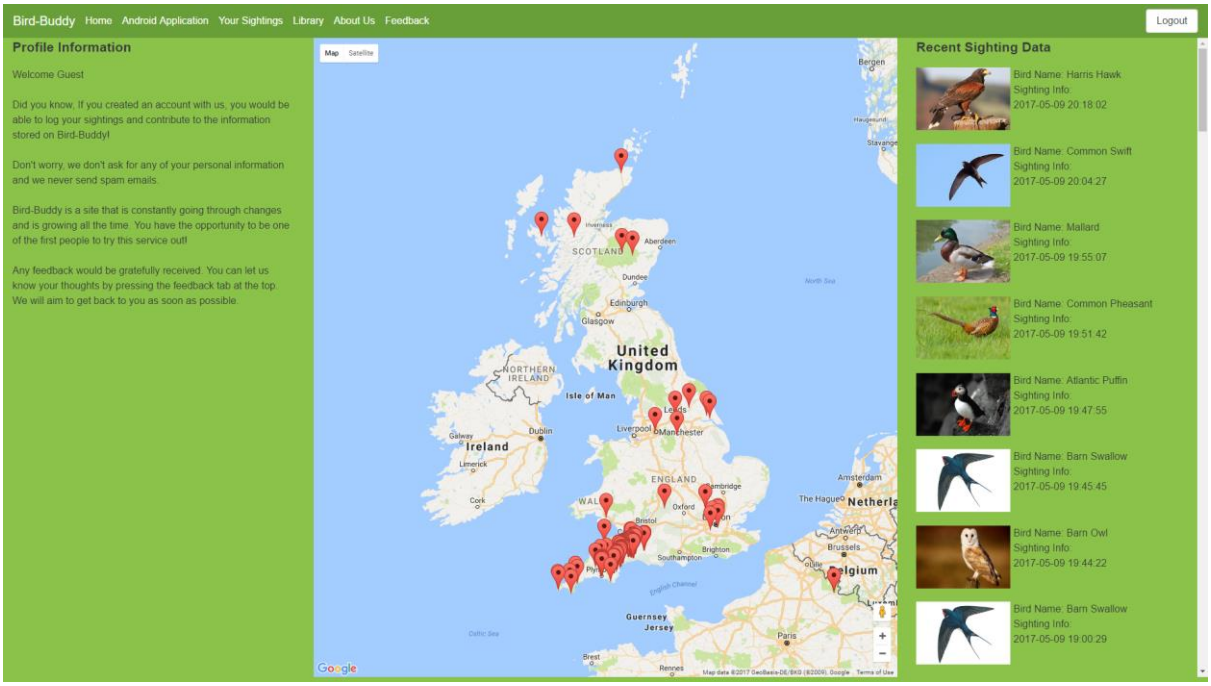
The “About Us” tab, shows the user some information about the development process and when they should expect updates on the project.



The final page you can access on the website is the feedback page. This is the page where you are able to send the developer any feedback about the application. This can be used to report any sightings that you may think were logged incorrectly.



This is the page that you will see when you enter the website if you are a guest. The information is mostly the same, but you are prompted to create your own account here.



Appendix C: Proposal + PID

Proposal

I propose to create an Android based application named “Bird Buddy” that allows users to search for Birds in the UK and identify birds that they may have seen in the wild through a series of questions to determine the size, colour and beak type of the bird. My initial proposal is to include 50 birds that are located in the UK, however this data pool may increase during the later stages of development. This information will be stored in an SQL database (likely to be Oracle), that will dynamically update the information of the birds when the information is changed. Users will be able to submit their own images of the birds for the community to view and add to.

My proposed member of staff is Nigel Barlow as he has experience with Android application development.

PID

1. Introduction

Currently, there are apps available on the google play store and apple app store that can be used for bird watching. Since my initial creation document, I have made adjustments to my scope. This has been based off of research from potential users. After doing some research and speaking to some people that may be interested in using such an app, I have discovered that identification is not going to be the most crucial feature. Bird enthusiasts are likely to already know the species they are looking at. For this reason I have decided to change the scope to focus on storing the locations of seen birds instead of identifying them. My initial data will include 50 birds that are located in the UK. However, this data pool may increase during the later stages of development. Whilst I do not have a client, the project is being undertaken as it is something that interests me and I feel would be a good application if it were to be released.

2. Business case

2.1. Business need

The aim of my application is to allow users to research information about UK birds on the go as well as search for potential matches to birds that they believe they may have seen. This will also offer a “seen” list. Users will then have a list of birds they are yet to see. I am undertaking this project as it brings together two hobbies of bird watching and photography. It will also allow me to develop my application making skills. My current modules will enhance my application further. The main feature however is seeing where you are most likely to see specific birds based on previous knowledge of where they have been seen.

2.2. Business objectives

- Bring a modern approach to bird watching and nature in general
- Present the conservation status of all birds in the uk
- Present users with all the relevant information they may need on birds in the UK
- Give users the ability to show their bird pictures with a community of likeminded people

3. Project objectives

- Implement the beginning phase of an android application with the potential to release to the play store at a later stage
- Potentially create a website alongside to reach a larger audience
- Analyse user requirements for such a system

4. Initial scope

The proposed system:

- The user will be able to see birds in location by time of year
- The client will be able to add data when they see a bird. This will store the location co-ordinates, the time and date, the bird and the user that registered the data entry.
- The client will be able to create a list of birds that they have seen and then display a list of birds that they are yet to see.
- Search by location in some form

What I would like to do:

- For community images, an account must be created

- The client will be able to upload a picture of their chosen bird if they should wish. The community will then be able to view this.
- The bird was last seen at this destination
- You're most likely to see a ---- here

What I won't do:

- The proposed system is an Android Application. There will be no cross platform throughout this project, however this may be implemented in the future

What I could do:

- Potential for machine learning aspect, image recognition
- When creating data points, if this is the first time you are seeing a new bird, it will come up with a prompt saying "Are you sure it wasn't one of these?" This will only happen the first time you view a bird
- A website that shares functionality to reach a larger audience

5. Resources and dependencies

I have access to Android Studio and two Android test devices, with the potential for a third device later in the process.

I will need to purchase a virtual server to run my database from, this is something that I have never experienced before so there may be an initial learning curve.

6. Method of approach

Increment process of small scrums

- Develop the database
- Develop a basic layout for the application
- Develop middleware
- Develop the main features for the android application
- Finishing touches

7. Initial project plan:

There will be constant uploads to GitHub. Whenever there is new code a new version will be uploaded to GitHub to ensure everything is up to date.

Project Plan			
Stage	**Expected start**	**Expected Finish**	**Outcome**
Initiation	1 Dec	10 Dec	PID
Requirement Analysis	30th January	6th February	Analyse what needs to be done including the requirements and development techniques. Selection of virtual server
Initial Design	7th February	14th February	Design documents including anticipated GUI
Increment 1	15th February	9th March	Create the Database and majority functionality to the point that it is ready for integration with the app.
Increment 2	9th March	15th March	Middleware to connect the database information to the application
Increment 3	16th March	4st April	Core functionality to the application with testing
Increment 4	5th April	21st April	Remaining functionality with testing
Increment 5	22nd April	29th April	System integration with evaluation
Complete Report	30th April	10th May	PRCO 304 Report
Final changes	11th May	22nd May	

7.1. Control plan

- Highlight reports
- Review meetings with project supervisor

- Small end stage reports
- Risk management
- Exception reports
- Reviewing plans
- Pivotal Tracker

7.2. Communication plan

Review meetings with supervisor will be in place as per the control plan. Further communication will be made if needed. I will also plan meetings with either myself or a family member as a sort of stakeholder meeting to ensure I am meeting my project plan timings.

8. Initial risk list

Risk List	
Risk	**Management Strategy**
Schedule Overrun	Stick to the core plan, have meetings in place to ensure that I am sticking to the schedule.
Scope Creep	Extensive planning early on. Take scope creep in to consideration when thinking of new features. Create a core plan at the beginning to make sure all plans are covered.
Technology Failure	Continuous backup process. Use GitHub as a backup system.
Difficulty Learning	Seek help if there are serious issues, stick to the plan to ensure completion. Give contingency time to ensure it is completed to an acceptable standard
Data Collection	Have a placeholder image in place in case there aren't enough images
Not enough time for implementation	Make a list of key features that need prioritisation
Hardware failure	Have the information readily available on a backup device. Ensure work can be maintained on more than one machine.
Indecisiveness	Contact with project supervisor if there are any worries or factors that may need a second opinion.

9. Quality plan

Initial quality plan	
Plan	I will look at the plan intently initially to make sure everything is in place and thought through.
Requirements	Requirements will be checked to ensure everything is being covered and achievable. Meetings will be scheduled in to ensure I am keeping to the scope. Each requirement is going to be carefully looked over to ensure there is a strong quality and usability.
Design & Validation	The design is to be critiqued constantly to ensure there has been full normalisation and the application matches googles material design.
Incremental Verification and Validation	At the end of each increment, there will be time to critique what has been completed and whether there is room for improvement
Full system V&V	After full integration there will be some V&V to make sure everything works together
Evaluation process	Each stage will be fully evaluated to ensure there is no room for improvements
Final Changes	Apply the final improvements that have been discovered during the evaluation process

10. Legal, social, ethical and/or professional issues

One legal issue that may occur would be the use of pictures of birds online. I aim to keep this to a minimum to prevent copyright infringement. I am also trying to take as many pictures as I can so that hopefully I will be able to have a discography of each bird.

Another way in which I intend to prevent this is to allow users to submit their own images.

If there are user accounts, it is important to think about what information will be collected and what will be done with the information.

Another issue may be tracking locations, I will have to handle this in a suitable fashion to ensure the locations aren't stored when unnecessary

Data protection act

11. Any other issues that you wish to include

So far there are no other issues that I can think of. This will be updated if I think of any.

Appendix D: Exception Report – Stage 4

Project Name:	Bird Buddy
Date:	24/02/2017
Author:	Daniel Andrews
Owner:	Daniel Andrews

This document is subject to change. This document has been created in anticipation for the stage not being complete in time. At this current state, this is not the case. There is still a week left for me to make changes to the middleware. This document is being created if the Middleware is not completed in time.

Revision History

Revision Date	Previous Revision Date	Summary of Changes
24/02/2017	None	Initiation of Exception Report
31/02/2017	24/02/2017	The Extra time was not needed in the end

Purpose

This Exception Report has been created in anticipation for a Stage exceeding its threshold for tolerance. The document has been provided by the Project Manager/ Developer to offer recommendations of how to proceed this stage in the instance that the threshold is exceeded.

Initial Exception Report

Title

- Middleware Implementation

Cause

- Server doesn't support Java

Consequences

- Aspects of the past week that have been spent working on the Middleware can't be used. This has the potential to delay the project.

Options

- Revert to AWS, this will allow me to use Java as anticipated. However, with AWS I would need to transfer the hosting from the current Server, this would incur additional costs.
- Learn from the situation, make sure simple things like this are looked in to in the future to ensure something like this doesn't happen again

Recommendation

- Aim to still complete the Middleware in the allotted time
- Don't rush the implementation. If the Middleware isn't completed in time, I have contingency time in place in case an issue like this should arise

Lessons

- Learn from this mistake
- Always check that different stages will integrate before implementation
- Whilst this has been an issue, I detected the issue whilst I still have time. Whilst this has left me a week down, I still have time to make it back

Appendix E: Highlight Reports and Stage Reviews

Week 1

PRCO304: Highlight Report

Name: Daniel Andrews

Date: 08/02/2017

Review of work undertaken:

As this has been the first week, I have spent most of my time looking in what will be expected of my project. I have spent a considerable amount of time looking at the hosting and the requirements that I will need to fulfil. During this time, I have created a short anonymous survey to get an idea for who is likely to be using my application. After leaving the application for a day, I collected the results and began to analyse them. In this time, I received 23 responses. During this week, I have uploaded a lot of deliverables to the student portal. I have spent a lot of time reviewing my current work and what I will need to complete for a good project.

My only current concern is the hosting. This is something that I have spent a lot of time looking in to however I am still unsure what the best option is available to me. Pricing is not as issue, I just want to ensure there is something reliable in place to use.

During this past week, I have spent 26 hours on my project. This is slightly below the expected 30 hours. Unfortunately, I fell ill last week which took a day out of my schedule. This is something that will be addressed in the future and I aim to make this time back.

Plan of work for the next week: This week I aim to complete the designs for my Android application. This will give me a good idea of what the final application will look like. I aim to complete a working paper based model of my application to be used as a reference point. I will also continue to look in to the hosting options available to me during this time.

Ensuring the designs are in place will help me to set out a house style and ethos for my project. This will then be used throughout my project.

Finish sorting out the hosting. I have a few ideas for how the hosting will take place, however I need to confirm how I will do this in the following weeks as I will be moving on to the setting up of the database in the following week.

Date(s) of supervisory meeting(s) since last Highlight: 03/02/2017

Notes from supervisory meeting(s) held since last Highlight

- **Look at AWS for hosting**
- **Sort out the hosting**

Stage review*:* During the last week I have completed my requirements section as per my plan detailed in my PID. This has included selecting the domain name for my website and ensuring I have access to all software necessary. The only thing that I need now is the hosting which I am currently looking in to. I am currently Looking in to AWS as suggested by my supervisor. I have signed up for an Amazon education account. This is something that I will continue to look in to whilst moving forward.

Week 2

PRCO304: Highlight Report

Name: Daniel Andrews

Date: 15/02/2017

Review of work undertaken This week, I have been working on the designs for the Android Application. I started by creating paper based designs for each different screen / activity that will take place in my application. I then annotated the drawings with information that I thought may need explaining.

I then started to look in to the different icons and styles that I would be using in the application. During this time, I created many different icons and colour schemes. These can all be found uploaded to the SPMS.

After this I recreated the paper based designs to use for a run-through of the application. I then recorded myself going through the application with a commentary about each different section. This has also been uploaded to the SPMS.

After creating the design video. I still had some time left in the week. Due to the additional time, I decided to look in to some future tasks. For the remainder of the week I started to create the designs in Android Studio. This is something that I was going to do in the third iteration. I have now completed the designs in Android Studio including the navigation drawer that will be used in the application. There are changes that will need to be made to the app however. In a lot of instances, I would place a placeholder image or something similar as I don't have the actual data yet. This is something that will be looked in to soon.

Plan of work for the next week. Based on my plan, this week I will be looking in to the MySQL database and getting it set up to use with the Application and Website. Whilst I will not be dealing with the Middleware at this stage, this week will involve creating the entity relationship diagram, creating the test data and creating all the tables that will be used in the database. During this time, I will need to test different options to ensure that there are no issues with the way that the database stores or relays information.

During this time, I will thoroughly test my database to ensure no errors arise. I will also look in to hosting the database in preparation for connecting to the Android Application.

I am currently unsure how I am going to store the images, I would image I will create a repository of images to use Server side. However, this is something that I will need to research.

Date(s) of supervisory meeting(s) since last Highlight

Notes from supervisory meeting(s) held since last Highlight

- Think about being able to modify/ moderate data points logged
- Have a system where users can flag data that doesn't look real

Stage review This has been a highly productive week. I have completed each task that I set out to complete with plenty of time to spare. For this reason, I proceeded to complete work that would be completed much later in the development stage. I have experienced a few issues in Android Studio, these are just standard bugs that you would expect whilst programming. I have resolved all the current bugs to date. I am now ready to continue on to the next stage of database development and integration with the Android Application.

Week 3

PRCO304: Highlight Report

Name: Daniel Andrews

Date: 23/02/2017

Review of work undertaken This week, I have been working on database implementation. This started by looking at each of the requirements and what I would need to record for the database to be a success. This included looking in to what could be recorded without causing concern to potential users. I then decided that I would only need to record a username, password and email address for each user.

After I looked in to the requirements for the database I created the database in MySQL workbench. After creating the database with the required boundaries in place. I started to add the data about each of the birds. This involved extensive research in to each of the 31 birds that are currently in the database. I received most of the information from the RSPB website, however a full breakdown of what information was found and where can be seen on the SPMS.

After creating all the data in the database, I focused on creating an instance on AWS. I also created an instance of the Web Server on AWS. For the full specification about the servers, I have uploaded a document to the SPMS.

Finally, I spent the rest of the week working on the report. This involved looking over multiple reports available on the SPMS to get a feel for what should be included. After this I looked at the documents made available on the DLE to understand the different sections that are possible to work on now. Currently I have spent around eight hours this week working on my report. I am at just under 4,000 words at the moment. This is however only a first draft.

Plan of work for the next week. Based on my plan, this week I should be continuing to work on the database. However, I have finished all of the functionality that I wanted to create in the database, this includes creating the Web Server and storing an instance of the database on AWS. Because of this, I will be starting to work on the Middleware two weeks early. I have created a new plan to reflect these changes and created a Gantt chart to accompany this. The Gantt chart in question has been uploaded as a Miscellaneous Deliverable on the SPMS and will be sourced as an Appendix in my final report.

From now on, each week I will also aim to update my report to the best of my ability. This may only mean updating a single section each week, however if I manage to do as much as I can now, I will have more time for perfecting the report later.

This week I intend on developing the Middleware for integration in the Android application. I will not be focusing on the middleware for the website until the Android application is complete / fully functional to an acceptable standard.

Date(s) of supervisory meeting(s) since last Highlight: 10/02/17

Notes from supervisory meeting(s) held since last Highlight

- Think about whether you will be continuing the project after university
- Don’t worry about the plan being slightly off. Estimation is difficult
- There’s no harm in starting on the report
- Think about how the images are going to be stored

Stage review Whilst I have completed all of the tasks that I wanted to this week. I feel like this hasn’t been as much of a productive week as last week. I believe this is because I am expecting too much from myself. I have finished all anticipated tasks and started work on my report. However as I still have a lot of work to do, it feels that this week hasn’t been as productive. I have created a full stage review for this week and it has been uploaded as a miscellaneous deliverable.

Week 4

PRCO304: Highlight Report
Name: Daniel Andrews
Date: 01/03/2017
Review of work undertaken This week, I have been working on the middleware. After deciding I would no longer use AWS, I have been setting up the database and webserver. I have been researching in to the implementation of a RESTful API, this is something that I will be developing in the following week. After the migration across was made, I realised that I would no longer be able to program the middleware in Java. This has slightly set me back. I have created an exception report based on this incident. I am currently unsure whether the report is needed, but I have created it just in case. As I am going to be programming the middleware in PHP now, I have been looking in to PHP server side code. This has allowed me to create a fully functional login system for my Website, as well as a support page that I will use in development. I have been looking in to the user testing that will take place later in the project. As my designs are complete and functional, I have based the questions off what I would like to know from my initial designs. This may change slightly as the process is developed further. However, I have developed a plan for the testing and filled out an ethics form for reviewing by my supervisor. This will then be sent off to ensure I am able to complete the user testing.
Plan of work for the next week. Based on my updated plan, I will be continuing the work on the Middleware this week. I will also focus on the continuation of my report. As I am currently in unfamiliar territory, I will be implementing aspects of the Website to get to grips with PHP during this week. This may set me slightly back on my plan, however I have contingency time available at the end of the project. I have also created an exception report in case I do overrun my schedule. I will also be looking in to setting up an ethics report for user testing. Finally, I have enquired with some family friends to see if I will be able to use some of their bird images for my database. I have created a document for them to sign to say that it is okay for me to use the images. This will be attached as an appendix to my report when I have all of the responses.
Date(s) of supervisory meeting(s) since last Highlight: 24/02/17
Notes from supervisory meeting(s) held since last Highlight - Change the report so that it doesn't just say "The developer has done this" etc - Start working on the Middleware
Stage review
Week one of this stage hasn't gone exactly as hoped. As I have now set everything up on my new Server, I will be keeping it there. However, I now have to change the middleware. This is something that will take some time. Whilst the programming aspects haven't been as productive as anticipated, I have worked very hard on the report. I am currently at near 5,500 words. Whilst I am aware that this is likely to change as the project progresses, I feel like it is very beneficial to get a head start on this topic as it is a very large essay.

Week 5

PRCO304: Highlight Report
Name: Daniel Andrews
Date: 09/03/2017
Review of work undertaken This week I have been creating the necessary PHP scripts for the middleware to function. I have created most of the necessary scripts needed for the website and integration with the Android client. I have been following up my work on the report and updated the changes that my supervisor has asked me to do based off my meeting last week. I am now at a stage where my report is up to date and I won't need to update it until the end of this stage. This will only be updating a single section so it won't take very much time out of the following week. I am pleased with my report so far, I feel like it has been a good idea to get as much of it out of the way at this stage so I am able to spend more time working on the project nearer the deadline without having to worry about writing large amounts of the report. During this week, I have been doing some more research in to the birds that will be used in my system. I have been trying to receive as many images as possible from friends of the family. This is proving successful so far, I currently have an image for most of the birds that I will be using in the initial stint. However, there are still a few birds that I need images of to be able to use without breaking copyright laws. This is something that I will continue to look in to in the following weeks.
Plan of work for the next week. Next week, I will be continuing my work on the Middleware, hopefully this will be finished by the end of the week. If I manage to complete this work before the end of the week I will be moving on to the core functionality of the Android Application. At this stage, the majority of the website will be complete and ready for user testing. Upon the completion of the Middleware I will review the work undergone on the website to ensure it is up to the standard that I would like it to be. I will also evaluate it based on the user testing questions I have created. Next week I intend to spend a considerable amount of time on my project. This week I haven't achieved the full 30 hours due to an unforeseen illness that has taken two days out of my development cycle. This mixed with the teaching module has made my hours suffer this week. This is something that I will address in my report. I have also dropped one day at the school for the following few weeks. This will ensure that I am able to complete the necessary work to stay on track with my plan.
Date(s) of supervisory meeting(s) since last Highlight: 02/03/17
Notes from supervisory meeting(s) held since last Highlight - Change the report so that it doesn't just say "The developer has done this" etc - Continue working on the Middleware
Stage review
This week has been more productive than the previous week. I have sent off my ethics approval documentation. This will help me later on in the project when I need to start the user testing as I won't need to wait around for approval. I have also made a decent start in to the Middleware. Fortunately, I have a week left to do the middleware before I need to worry. As I have made a decent start in to the Middleware this is not a major concern for me at the moment. I have updated my Exception Report to relay these thoughts. The Middleware should be finished in the following week. After this I will be able to work on the core functionality of the Android Application. After the Middleware has been sorted, the website will have most of the functionality that I need it to have at a base level.

Week 6

PRCO304: Highlight Report

Name: Daniel Andrews

Date: 16/03/2017

Review of work undertaken This week I have completed my work on the Middleware. This has involved integrating the PHP scripts with the Android Application and Website.

- You are now able to view all birds in the database on both the Android Application and the Website.
- You can login and Register on both the Android Application and Website
- You are able to report sightings that you don't think should exist on the Website
- You are able to Send feedback on the website
- You are able to change your password
- You are able to run through the website properly. Previously I had it so you would just be able to enter different php file names to view the functionality. This is the same with the Android Application.

This is most of the functionality that I require for the website to be operational. I will now focus on the completion of the Android Application. After this is complete I will undergo user testing before making additional changes to the systems.

I have also created some supporting documentation for the middleware being programmed in PHP instead of Java. There is also a document about the progression of the website. I have also completed a document about the information that will be stored about the user.

Plan of work for the next week. As the middleware is now complete. Next week I will be focusing on the core functionality for the Android Application. This will involve the logging of sighting information and being able to view the information that requires the Google Maps API.

During this stage, I will also be setting up the Maps API in Android to run efficiently. By the end of this week, most of this work should be completed. However, I have given myself two weeks to do this work in case there are any issues, I still have some contingency work at the end of the project just in case there are any additional issues during this stage.

Additionally, when the sightings are up and running, I will focus on integrating the sightings within the website as this will be the remaining functionality necessary on the website. After this week, I should have completed all development needed for the user testing.

During this stage, I will break up the programming by reviewing my previous work and evaluating the website that I have developed. I will do this by looking over at the plans that I had for the website and evaluating the functionality based on my user testing questions. As my ethics testing application has now been approved. I will be able to move on to the user testing as soon as the Android Application is ready at the end of this stage.

The user testing will involve checking my application with potential users in my home town and fellow course mates studying this module.

During this time I will also log some real data using the application in different locations.

Date(s) of supervisory meeting(s) since last Highlight: 10/03/17

Notes from supervisory meeting(s) held since last Highlight

- Continue with the Middleware
- Ensure you are writing why you are doing things in your report (V&V)
- Nigel has given me some code to have a look at for the Middleware between the Android Application and the database on the server

Stage review

All in all, this stage has been the least successful of all of the stages I have undertaken. This could be due to the mix up with the server at the beginning of the stage. However, this issue has now been resolved and I am back on track for the completion of this project. There have been some unfortunate days in the past few weeks where I have been unable to complete the necessary work due to illness and other arrangements with the school (other module this semester). Fortunately, this has since been resolved and I have a new-found drive for the completion of this project. I found that I began to get stuck in a rut in the middle of this stage, this was due to learning new technologies that I was unaware of. This has since been rectified and the work that I have created is sufficient for the task as hand.

My progress this week has been significantly more beneficial to the project than that of the work completed last week. I am beginning to piece everything together now.

Week 7

PRCO304: Highlight Report
Name: Daniel Andrews
Date: 22/03/2017
Review of work undertaken: This week I have been working on the Android Functionality. This has involved dealing with JSON encoding. I have successfully integrated this in to the Application. Currently, this is only being used for the database of the birds and viewing all information about the birds. This will be used for viewing your sightings and nearby birds as soon as this functionality is available. I have also been working on making the sighting functionality work. During this time, I have been able to get a representation of the GPS system working. For the sighting to be able to work you must be able to login, search for a bird and have the co-ordinates. You are currently able to login, search for a bird and find the devices location. I just need to put this all together now and you will be able to log your sightings. When this does work, I will be able to implement the JSON lists for "your sightings". I will then be able to work on nearby birds, which will be based on sightings within a certain radius from you and logged recently. After this functionality is working I will be working with the Google Maps API. During this stage I have worked on fixing bugs within the Android Application.
Plan of work for the next week. I am now well in to working with the Android functionality. During the second week of this stage I will be working on completing the logging of sighting information and being able to view the information that requires the Google Maps API. During this stage, I will also be setting up the Maps API in Android to run efficiently. Additionally, when the sightings are up and running, I will focus on integrating the sightings within the website as this will be the remaining functionality necessary on the website. After this week, I should have completed all development needed for the user testing. The user testing will then take place at the end of this stage. The end stage date is 4/04. This gives me a bit of time at the end of next week to finish any remaining functionality that hasn't been implemented. My user testing will involve checking my application with potential users in my home town and fellow course mates studying this module. During this time, I will also log some real data using the application in different locations.
Date(s) of supervisory meeting(s) since last Highlight: 17/03/17
Notes from supervisory meeting(s) held since last Highlight - Ensure you are writing why you are doing things in your report (V&V) - Keep in mind the second marker and external marker when writing report - Research in to image storing
Stage review
I feel like I have had a good start to this stage. There have been times where the code just hasn't worked. This can be expected. I have spent a lot of time this week fixing bugs from previous development, this has been beneficial to the state of the app. I have also managed to get functionality working which is great. I have been researching in to the caching of information in the Application, this is something that I will continue to work on next week. Things are looking good now. I am integrating functionality together now and it is going relatively well.

Week 8

PRCO304: Highlight Report
Name: Daniel Andrews
Date: 29/03/2017
Review of work undertaken: This week I have been working on the Android Functionality. I have been working on completing the sighting information and loading more information in to the application through Bundles. I now have multiple sightings within the application and you are able to view your own list of sightings in the application. The remaining functionality should be complete by the end of the following week. Unfortunately, I have had to take a large portion of time out of my project work this week due to conflicts with my other module during this semester. Fortunately, I am coming to the end of the work for the second module, I only have one more week left at the school. I have also completed most of the essay for the teaching module. It is currently looking like I won't reach 30 hours of project work this week. But I still have Friday to Sunday to make up the time.
Plan of work for the next week Next week I will be finishing the android functionality. This will involve the completion of the analysis within the application. This will involve working with the Google Maps API. I will also need to work on the nearby birds. This is likely to be a difficult feature to implement, but it is crucial for the application that I would like to implement. After this I will be working on adding the new functionality to the website before moving on to the user testing.
Date(s) of supervisory meeting(s) since last Highlight: 24/03/17
Notes from supervisory meeting(s) held since last Highlight - Ensure you are writing why you are doing things in your report (V&V) - Keep in mind the second marker and external marker when writing report - The meeting next week will not be at the same time. We will organise something for the following week due to my arrangements with the school
Stage review
This stage is currently still going well. I have a lot of functionality in place now for the application, but there will always be more features to add. I am happy with the progress that has been made, but there still seems to be a lot of functionality left to implement. Things are looking good now. I am integrating functionality together now and it is going relatively well.

Stage Review – Stage 2: Designs

Starting in the second week, this is a document that I plan on creating each week to make sure I am on track to complete the project. This document will also detail moments where I may have gone off track from the original plan. This document will serve as a way for me to evaluate the work that I have completed and ensure that the work I am completing is of a high standard.

At the beginning of each week I will answer the following questions below to the best of my ability. At the end of the week I will then revisit this document and fill in the actual results. This will serve to make sure I don't forget any of the small details whilst undergoing this project.

Week 2: Design Stage Date: 06/02

Plan:

Estimated Time:

1 week (07/02 – 14/02)

Brief description of what you plan to do:

This week I intend on creating all the designs and icons that will be used in my application. These designs may also be used in the website. For this reason, it is important that I spend a lot of time looking in to potential themes / colour schemes to use for my application. I will also take this time to analyse existing systems that are already in place to look at the ways that the apps work. For this I, will be downloading applications from both the iOS app store, and the Google Play store.

Expected Deliverables:

- Paper based designs for each different screen
- A logo for my application
- A house style / ethos colour scheme

Expected Risks:

- Schedule overrun
- Spending too long creating designs

Actual:

Are you on schedule:

At this stage, it is too early to tell. However, I have made decent progress and I am currently ahead of schedule. I am not going to take this for granted as I know that there is a lot of work to do, most of it is completing tasks that I haven't completed before. So, I don't know how difficult they will be.

Actual Time:

4 days (07/02 – 10/02)

Brief description of what you did do:

This week I have developed two different paper based designs for my application. I have also created various icons that will be used in the application. I spent a lot of time looking in to themes that I could use, this was based on the material design that Google suggests you should use when developing android applications. Eventually I decided to opt for a green design. I started with a blue background, however this made my logo look a lot like the twitter icon. I also analysed existing applications from each app store to see how they work and what is good about them.

Deliverables that have been produced:

- Two different paper based designs, one as a video run through of the application, the other as an annotated design of how the app will work
- Multiple potential logos to use for my application
- A decided colour scheme to use throughout the application and website
- A document discussing existing systems and the advantages that they bring

Risks:

- Finding an application like that of the one I intend to create. Fortunately, this didn't happen
- Creating logos that are too like existing systems. This did happen, however I adjusted my logo to deal with this

Issues that were identified/ resolved:

- My logo was like the Twitter logo, to deal with this I changed the colours of my application
- When creating the application on Android Studio I came across multiple bugs when creating the navigation drawer. This is something that took a lot of debugging to find the cause, however they were small errors that have since been resolved

Changes made to plan:

- My plan didn't take in to consideration the fact that I might finish early
- I have created the designs in Android Studio, this wasn't something that I expected to do at this stage. Doing do has made me feel more confident about the project as I have something to show now

Stage Review – Stage 3: Database and integration with application

This is a document that I plan on creating each week to make sure I am on track to complete the project. This document will also detail moments where I may have gone off track from the original plan. This document will serve as a way for me to evaluate the work that I have completed and ensure that the work I am completing is of a high standard.

At the beginning of each week I will answer the following questions below to the best of my ability. At the end of the week I will then revisit this document and fill in the actual results. This will serve to make sure I don't forget any of the small details whilst undergoing this project.

Stage 3: Database development Date: 13/02

Plan:

Estimated Time:

3 weeks (15/02 – 9/03)

Brief description of what you plan to do:

During the first iteration, I plan on creating the database that will be used to store the information about all of the different birds in my database as well as storing each sighting. During the first week, I intend to create a list of the required tables as well as full normalisation. During the first week, I will also look in to adding some test data. During the following week, I will look in to the integration with the Android application.

Expected Deliverables:

- Analysis of different database types (selecting most appropriate one)
- An initial ERD
- A normalised database

Expected Risks:

- Schedule overrun
- Uncertainty

Actual:

Are you on schedule:

At this stage…

Actual Time:

6 days (07/02 – 12/02)

Brief description of what you did do:

I have realised that I have given myself too much time at this stage. I will use the spare time to work on the Middleware. This will be talked about in the next Stage. This stage I have created my ERD and looked in to the different database types.

Deliverables that have been produced:

- Analysis of different database types, selecting the best available choice for myself

- An initial ERD
- Normalised database

Risks:

- Schedule Overrun
- Indecisiveness

Issues that were identified/ resolved:

- All different types of database have been looked in to during this stage. I have now decided I would use a MySQL database.

Changes made to plan:

- I have made drastic changes to my initial plan this week. Whilst I was under the impression that setting up the database would take me three weeks, I have found setting it up has taken a lot less time than anticipated. For this reason, I am going to discuss with my Supervisor whether he thinks I should make changes to my initial plan.

Stage Review – Stage 4: Middleware

This is a document that I plan on creating each week to make sure I am on track to complete the project. This document will also detail moments where I may have gone off track from the original plan. This document will serve as a way for me to evaluate the work that I have completed and ensure that the work I am completing is of a high standard.

At the beginning of each week I will answer the following questions below to the best of my ability. At the end of the week I will then revisit this document and fill in the actual results. This will serve to make sure I don't forget any of the small details whilst undergoing this project.

Stage 4: Middleware Date: 13/02

Plan:

Estimated Time:

3 weeks (13/02 – 09/03)

Brief description of what you plan to do:

During this stage. It is my intention to complete the Middleware that will be used to work from the server to the Android Application and the Website.

Expected Deliverables:

- Scripts for each functionality point on the website
- Scripts for each functionality point on the Android Application

Expected Risks:

- Schedule overrun
- Uncertainty

Actual:

Are you on schedule:

At this stage I think it is hard to tell. There has been an issue with the server so I am uncertain. Fortunately, I have contingency time,

Actual Time:

4 weeks (13/02 – 20/03)

Brief description of what you did do:

This stage has been a slight problem. I have experienced issues with the integration of my middleware and my server. This was a problem that was overlooked when selecting a server. With this in mind, I am happy with the progress through this Stage. I took an extra week to complete what I wanted to complete. But it is done now and I am pleased with the results.

Deliverables that have been produced:

- Scripts for the expected functionality of the Android Application
- Scripts for the expected functionality of the Website

Risks:

- Uncertainty
- Schedule Overrun

Issues that were identified/ resolved:

- Unfortunately, it was discovered that my intended Middleware would not be functional with my server. To make up for lost time, I started to work on the PHP scripts straight away. Whilst I have gone slightly over schedule, there is still time to make it back.

Changes made to plan:

- This stage, I have used an extra week that I hadn't expected to use. This will be fine in the long run I am hoping.

Stage Review – Stage 5: Android Development

This is a document that I plan on creating each week to make sure I am on track to complete the project. This document will also detail moments where I may have gone off track from the original plan. This document will serve as a way for me to evaluate the work that I have completed and ensure that the work I am completing is of a high standard.

At the beginning of each week I will answer the following questions below to the best of my ability. At the end of the week I will then revisit this document and fill in the actual results. This will serve to make sure I don't forget any of the small details whilst undergoing this project.

Week 6: Android Development Date: 20/03

Plan:

Estimated Time:

2 week (20/03 – 04/04)

Brief description of what you plan to do:

During this iteration, I will be working on the majority of the Android functionality. At the end of this stage, most of the necessary functionality will be completed for the Android application. I will then transfer this functionality across to the website.

Expected Deliverables:

- View All birds on the Android Application
- View information about each bird on the Android Application
- Log a sighting
- View your sightings
- Search for birds in the system
- Login
- Register
- Logout
- View where you are most likely to see a bird
- View where a bird was last seen
- View nearby birds

Expected Risks:

- Schedule overrun
- Uncertainty
- Lack of understanding
- Working with new technologies

Actual:

Are you on schedule: I think I am on track at the moment. By the end of this stage, most of the functionality will be complete, so providing I am on track to complete this stage. I will be able to complete the project in time.

At this stage…

Actual Time:

1 week in currently. It is hard to tell at this moment.

Brief description of what you did do:

This week I have …

Deliverables that have been produced:

- Login to system
- Register to system
- View all birds in the Android Application
- View information about each bird on the Android Application

- Search for birds in the system

Risks:

- Working with new technologies

Issues that were identified/ resolved:

- During the first week, I have experienced a few issues with the implementation of features. This has been down to not using Android for development for a while. After a few days, I managed to create a lot of the functionality that I wanted to.

Changes made to plan:

- During this week, I have made no changes to the plan. At this stage, I don't think there will be too many changes to the plan until the user testing starts.

Stage Review – Stage 6: User Testing

This is a document that I plan on creating each week to make sure I am on track to complete the project. This document will also detail moments where I may have gone off track from the original plan. This document will serve as a way for me to evaluate the work that I have completed and ensure that the work I am completing is of a high standard.

At the beginning of each week I will answer the following questions below to the best of my ability. At the end of the week I will then revisit this document and fill in the actual results. This will serve to make sure I don't forget any of the small details whilst undergoing this project.

Stage 6: User Testing Date: 04/04

Plan:

Estimated Time:

2 week (05/04 – 21/04)

Brief description of what you plan to do:

During this iteration, I will be working on the majority of the Android functionality. At the end of this stage, most of the necessary functionality will be completed for the Android application. I will then transfer this functionality across to the website.

Expected Deliverables:

- User Testing Questions
- User Testing Feedback
- Changes made to Android Application
- Changes made to website

Expected Risks:

- Too many changes to make
- Schedule Overrun
- Not good enough testing

Actual:

Are you on schedule:

I believe I am on track. The changes have been made and I am happy. There are just a few things that I need to do to the Android App and website. I also need to finish the report.

Actual Time:

1 week of testing, 1 week of development changes.

Brief description of what you did do:

This week I have completed

Deliverables that have been produced:

- Effective user testing
- Small changes to the application that will be beneficial
- Places where I can improve

Risks:

- Too much feedback. This will not all be implemented
- It took a while to set up the user testing sessions

Issues that were identified/ resolved:

- During this Stage, the only issue found was that it took too long to get the user testing sessions with course mates as they are all currently working on their projects too.

Changes made to plan:

- During this week, I have made no changes to the plan. At this stage, I don't think there will be too many changes to the plan.

Stage Review – Stage 7: Final Changes

This is a document that I plan on creating each week to make sure I am on track to complete the project. This document will also detail moments where I may have gone off track from the original plan. This document will serve as a way for me to evaluate the work that I have completed and ensure that the work I am completing is of a high standard.

At the beginning of each week I will answer the following questions below to the best of my ability. At the end of the week I will then revisit this document and fill in the actual results. This will serve to make sure I don't forget any of the small details whilst undergoing this project.

Stage 7: Final Changes Date: 05/04

Plan:

Estimated Time:

1 week (22/04 – 29/04)

Brief description of what you plan to do:

During this stage, I have been making the final changes that I will be making to my Android Application and Website.

Expected Deliverables:

- Creating new functionality points to the Android Application
- Finishing the work on the website
- Think about future development
- Decide whether the project will be continued after the project is completed

Expected Risks:

- Schedule overrun
- Uncertainty
- Lack of understanding

Actual:

Are you on schedule:

I feel like I am currently on track to complete the project with a few days to spare. I am at a point now where I am adding new functionality constantly.

Actual Time:

1 week.

Brief description of what you did do:

This Stage, I have focused on creating more functionality points for the Android Application. I am getting to a point where I am developing beyond my core functionality points now.

Deliverables that have been produced:

- View birds by location
- View birds by time of year
- View all sightings per bird
- View Birds by habitat

Risks:

- Schedule Overrun

Issues that were identified/ resolved:

- There haven't been any issues during this stage. I have had to limit the work that I am doing as otherwise I may spend too much time working on new functionality instead of finishing the project.

Changes made to plan:

- During this week, I have made no changes to the plan. At this stage, I don't think there will be too many changes to the plan until the user testing starts.

Stage Review – Stage 8: Report Writing

This is a document that I plan on creating each week to make sure I am on track to complete the project. This document will also detail moments where I may have gone off track from the original plan. This document will serve as a way for me to evaluate the work that I have completed and ensure that the work I am completing is of a high standard.

At the beginning of each week I will answer the following questions below to the best of my ability. At the end of the week I will then revisit this document and fill in the actual results. This will serve to make sure I don't forget any of the small details whilst undergoing this project.

Final Stage Date: 30/04

Plan:

Estimated Time:

2 week (30/04 – 10/05)

Brief description of what you plan to do:

It was the initial plan to spend this time working on the full report, in actuality I have been updating the report as I have been working through the project. This has allowed me to spend this time working on final changes instead of

Expected Deliverables:

- Final Report
- Report Appendices
- A functional Android Application
- A functional Website

Expected Risks:

- Schedule overrun
- Uncertainty

Actual:

Are you on schedule:

Yes

Actual Time:

In actuality. This stage has taken all of the remaining time of my project. This has been due to the fact that I wanted to complete the project to a high standard.

Brief description of what you did do:

This stage, I have completed the project to a standard that I am happy with. The project will never truly be complete, due to the nature of software development. But I am at a stage where I am happy with what I have created.

Deliverables that have been produced:

- Final Report
- Report Appendices
- Final Changes to Android Application
- Java Docs
- Final Changes to Website

Risks:

- Schedule Overrun

Issues that were identified/ resolved:

- During this stage, I often had issues with running over the word count. I had to find a suitable way to make the correct changes, this was quite difficult for me at the beginning of the stage, near the end I was able to stick to just below the word count.
- In the very last week, my computer keyboard broke. Initially I thought that it was just the batteries gone, but after replacing them twice, the keyboard still wasn't working. Luckily, I have two devices for development. So, this wasn't an issue for me.

Changes made to plan:

- I initially didn't think this stage would take this long. However, I did realise that this is the final stage of the project so it is expected.

Appendix F: Technologies Used

I have included below a list of the technologies used throughout the project. Where applicable I have included the reasoning for the selection of a certain technology over other technologies.
In my website, I have made use of many different web technologies these include:

- HTML (5)

HTML is being used as the core structure for my website

- CSS

CSS is being used for the styling of my website. This may be integrated in to a Bootstrapping solution at a later stage.

- JavaScript

JavaScript is being used on my website

- jQuery

I haven't decided how I will be using jQuery yet. I do know that it will be implemented in to the website in some places however.

- APACHE

APACHE is being used in the hosting. I am using LAMP for my project. Apache is being run server side, my hosting is through EcoWebHosting. I was initially using AWS, however the estimated cost was too high to warrant continuation of the service. EcoWebHosting are also offering me a lot more functionality with them that would cost money in AWS.

- PHP

PHP will be used for my Server Side code. PHP powers over 80% of the web, for this reason I will be using PHP as my server side code. PHP will be used for any request that requires server integration. This includes the middleware for the Android Application.

- MySQL

MySQL is the database language that I am using. I have looked in to many different database languages in the preparation and decided that MySQL would be the most appropriate for my project.

- Bootstrap

I am going to look in to the different Bootstrap options available for me to use in my website. This is going to be difficult as I plan to implement the Google Maps API in the system.
PHP powers over 80% of the web

- Android

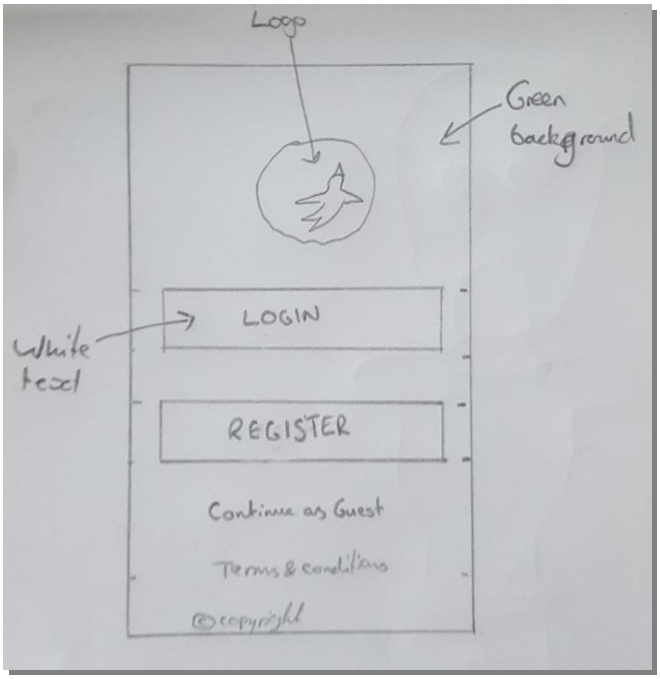
Java is being used in my Android application for the programming of different aspects within the Android application.

Appendix G: Android Application Initial Designs

I have recently been undergoing my designs for the Android Application. This has been an extensive process as there is a lot to think about. When looking at the designs, it is important to have your target user in mind. As the target age group appears to be varied for my project (from the results of my survey), I aim to keep a simplistic user interface with only the crucial information available. Below I have included the proposed designs for my application, including a few copies of the logo and different icons that will be used in the app.

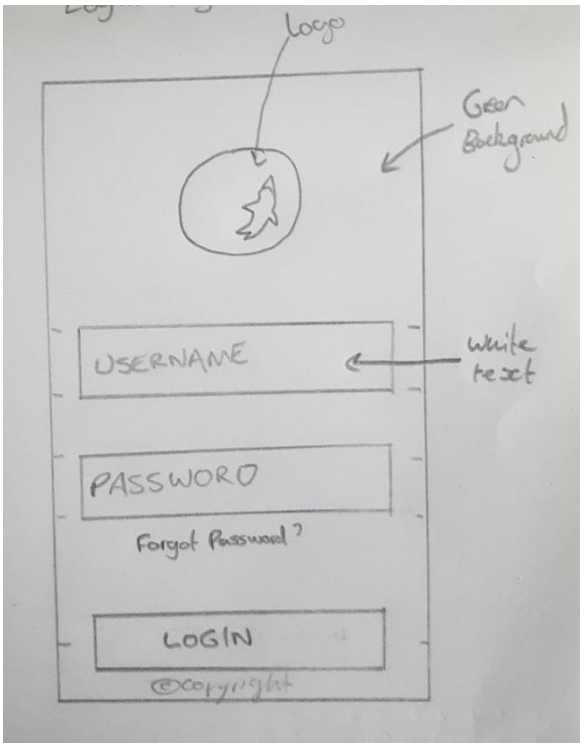
App layout:

Initial Screen:



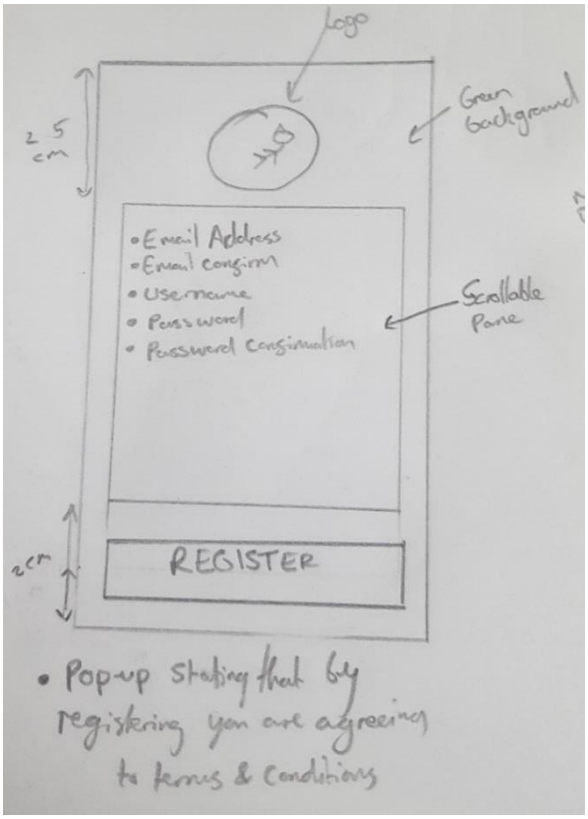
This is my initial proposal for the first screen that you will see when you access the application. As you can see, there is the option to login to the app, register to be a new user, or continue as a guest. The main difference when you are a guest, is that you aren't able to create data.

Login:



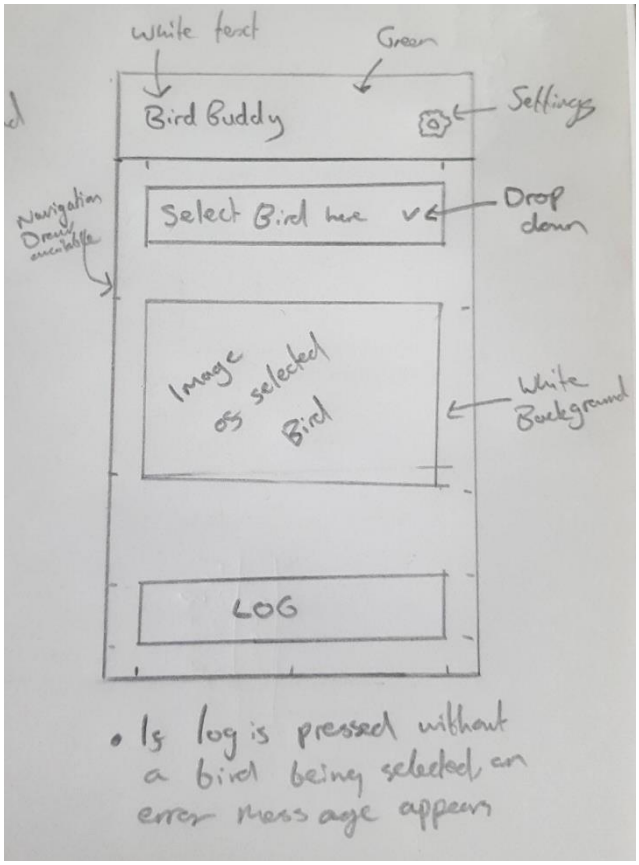
Here is my proposal for the login screen. You will be prompted to enter your username and password. There is also an option for if you forget your password. You can also see the logo at the top of the page.

Register:



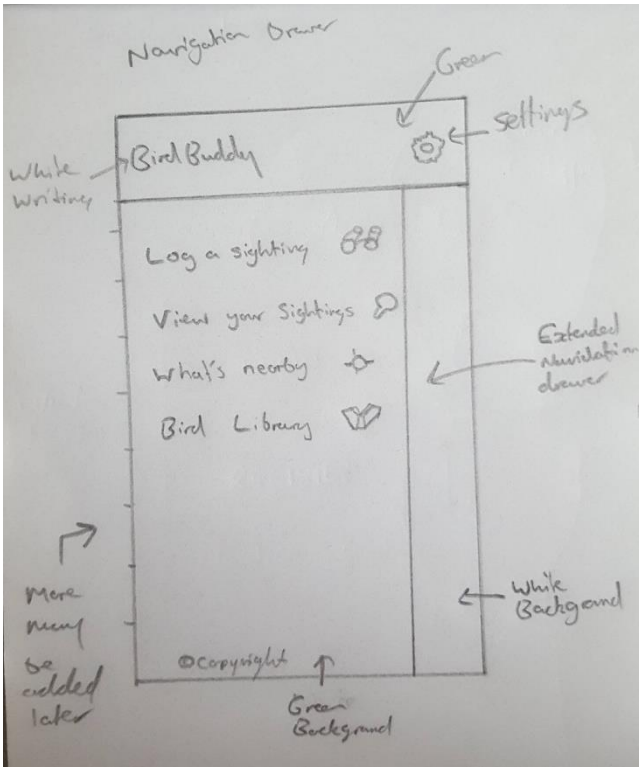
This is the register screen. As you can see, upon registration you are required to give an email address twice, a username and password twice. This is to prevent too much personal data being collected. Whilst this is not an issue for some people, there are some people that are sensitive about their personal information such as their name and age. This also aids in abiding by the Data Protection Act. This is also the time in the app where you agree to the terms and conditions. This is just to prevent any illicit legal actions.

Log a sighting:



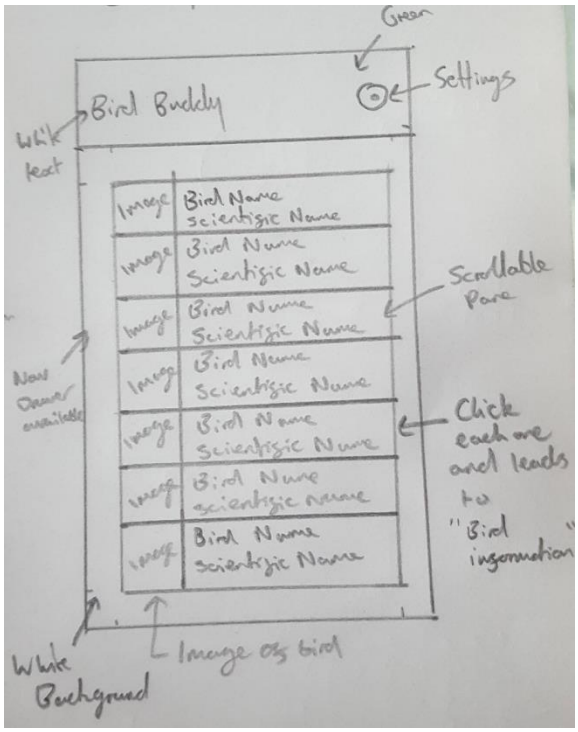
This is one of the most crucial screens in the application. To keep it as simplistic as possible, there is a drop down box where you can select your bird of choice. This may however change to a search box in the future depending on the ease of use and user feedback. Underneath the dropdown box there is going to be an image of the bird selected, this is going to be there to make sure you are 100% sure that the bird you have selected is the bird that you saw. Then you just need to press the log button and the information will be saved. As you can also see, there is a navigation draw available to slide in from the left side of the screen.

Navigation Drawer:



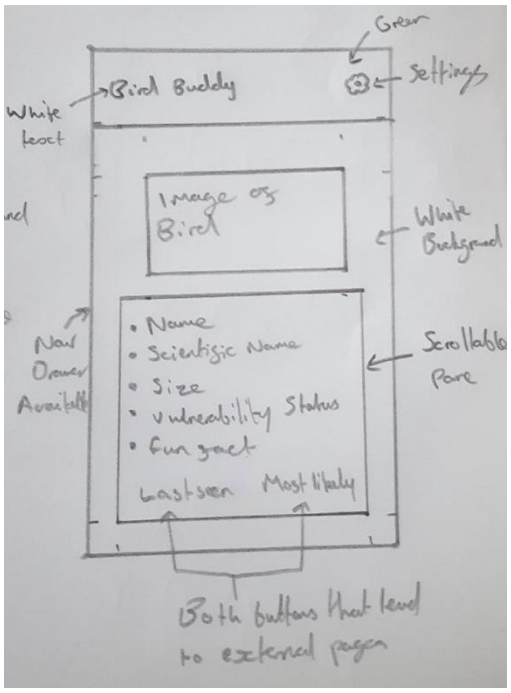
This is the first iteration of the Navigation Drawer, as you can see beside each different option available, there is a small icon. I will create each of these icons myself to be used with the application. There may be a crossover with the website however I'm not sure yet. It was my aim to make as much functionality as possible accessible through a simple navigation drawer, this would make the interface much less cluttered and me more in line with the material design that Google offers instead of the way that apple iOS are usually developed. Currently there is space to add more features, this may be changed in later iterations as I may add additional features or have different features in the navigation drawer.

List of Birds:



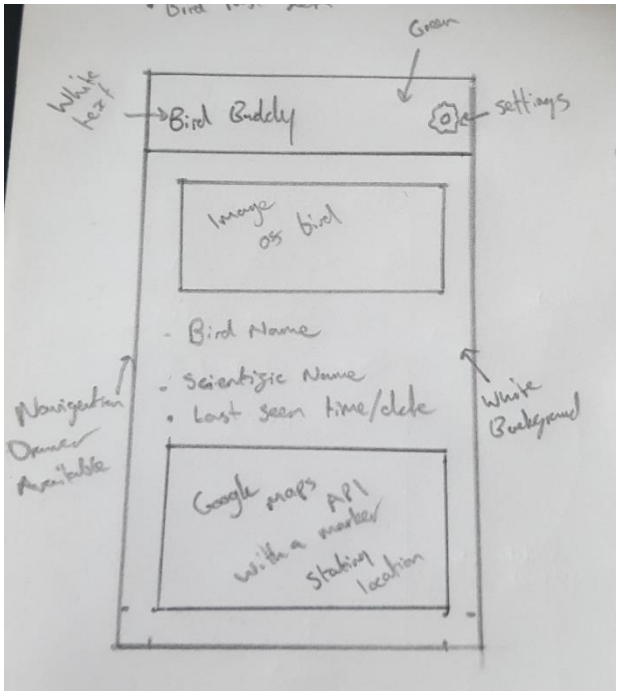
This is going to be one of the features in the navigation drawer. The list of birds is simply a list of all of the available birds, this will start with around 10, then move up to 50 by the end of the project. This may increase to a larger number depending on how the development goes. This is a scrollable pane that simply scrolls through the list of birds. I haven't decided the ways that the results can be arranged yet. Currently it will just be A-Z. The results will simply show an image of the bird, the name of the bird and the scientific name. This can be used for simple identification of birds. However, you are also able to click on each different instance to the birds. This will then give you more information about them.

Bird Information:



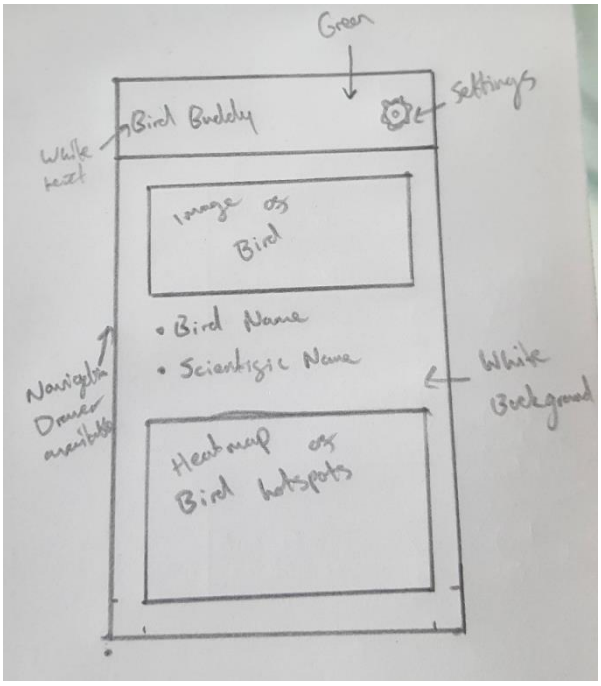
This is the screen that you will get when clicking on a row on the screen above (based on the library). You will be returned with an image of the bird, the name, scientific name, size of bird, vulnerability status, fun fact and then be given the option to see where one of these birds was last seen, or where you are most likely to see this bird. These two last options will both be discussed in further detail below. This information can be used for the classification of birds if the user is unsure, or it can be used for the tracking down of hard to find birds.

Last seen:



The last seen is one of the buttons that you will be able to view when looking at the information of the birds. On this screen you are able to see the same image of the bird that you could see when looking at the information, however this time you are also able to see the time and date that the bird was last seen, as well as a pin on the Google Maps API of where it was found.

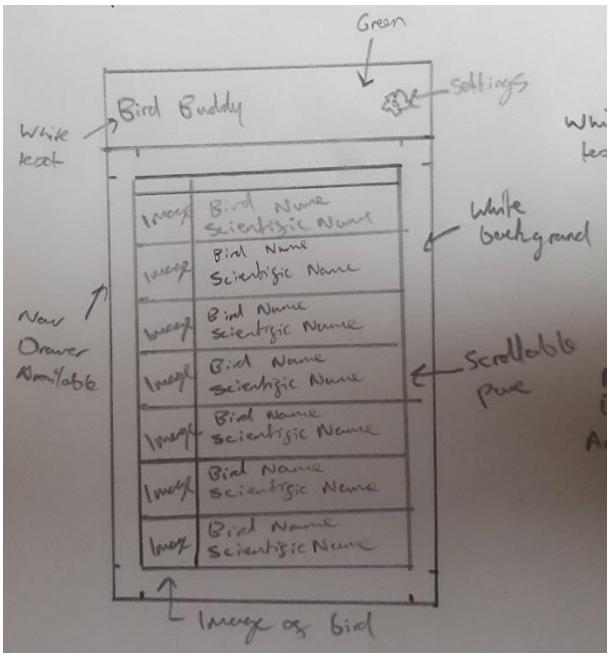
Most likely to see:



This is the screen that you will be relocated to when you press the button for searching where you are most likely to view the birds. This is currently a feature that is going to be

on the website, however I am unsure of how it will fit in to the Android application. There may be a heat map of the hotspots where you will be most likely to see the birds, or there may be a single counter that states this is where they have been identified the most in a 10-mile radius. Alternatively, the feature may not be there at all.

Near me/ List of seen birds:



These two separate features are going to yield a similar layout for the results, for this reason they have been grouped together. The results will simply be a list of the birds and their images, from here you will be able to click on the results and view more information about the birds. This may be changed closer to the time of development however. This may be changed so that you are able to see the time and date that you viewed the birds, and also change the list of seen birds to accommodate for multiple viewings or remove all viewings of the same bird so you have a list of unique results.

This has been a brief overview of the initial designs that I have created for my android application. Creating the designs for the website may me a more complex feat as there is a larger screen to deal with. This will be accounted for at a later stage. I will also upload a following document on the icons that I will be using in my application and the changes that I have made to them in development.

Appendix H: Changes to designs

Colour scheme:

My colour scheme was initially going to be blue, however I realised early on that with my current colour scheme, the logo looked very like the twitter icon. For this reason, I decided I would need to change the colour scheme used. Below I have included the Hex code used for the initial colours and the colours that they correspond to.

This first image would be what was used for the banner at the top of the screen, it would also be used for the initial few screens where the background is a blue colour instead of white.

#03A9F4

This image is the colour that would be at the top of the screen where the notifications would be. I have included a screenshot below of the two colours in conjunction on the basic layout of my app.

#0288D1

Here is the initial design for what is essentially the toolbar for the app. I am going to change the colours so it doesn't look like Twitter. I may also remove the three dots on the right-hand side of the screen and just leave the settings image. This is an icon that I created myself.

When I discovered the colour, scheme resembled Twitter, I knew I would have to make changes to make my application distinct. To do so, I had a look at the material design guidelines to ensure that I would be selecting a suitable colour. I also had a look at the meaning behind each colour to ensure that I would be picking a colour that is associated with calmness. After taking this in to consideration I decided to pick the colour green. Green is a colour that is associated with nature, it is a calm and refreshing colour that is often used in hospital waiting rooms to relax patients. [1] After taking the material design aspect in to consideration I decided to opt for: #8BC34A as the

primary colour, and #689F38 as the colour for the top of the screen. This makes the toolbar look like this now:

#8BC34A

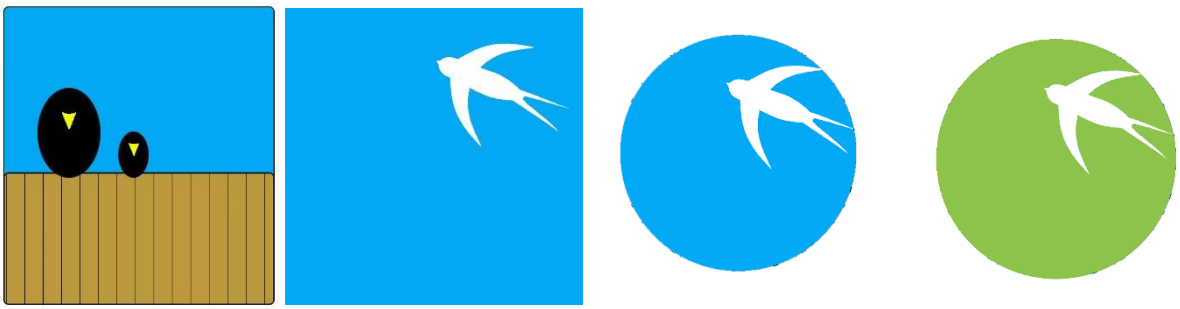
#689F38

At first I was slightly unsure about the change to the colour scheme, however I can see how it could have a calming effect. I have also made changes to my existing icons used. This will be documented below.

Icons:

Over the last few days I have created a series of icons for various parts of my application. I have made multiple different ideas for the core icon and then minor changes to different icons within the application. These are all likely to change as the development takes place but these are currently the icons that I have made.

Logo:



The left image is the first design that I made, followed by the second, third and fourth. As you can see not much has changed in the last three icons, I feel like I have settled with a good design that is simplistic enough to show what the application is about and keeps the colour scheme selected. The first image is supposed to symbolise two birds sitting on a fence, this may have been more crucial when the application was based on identifying birds. Now the app is based on the logging of seen birds, I feel like the second design is much more useful. The design is supposed to signify a bird flying in the sky.

Log a sighting:

This icon is supposed to be a pair of binoculars and will be used for logging sightings. I feel like this is a self-explanatory icon for bird watching. However, it may not be assumed when thinking about the logging of information. I wanted to keep the icons in line with bird watching activities so I have kept it this logo as a pair of binoculars.

Settings:

This is the settings icon. This is a well-established settings icon so there is no need to include the word here. This also gives a more minimal affect when looking at the application.

Your Sightings:

This icon is supposed to be a magnifying glass to show what you have seen. For this icon, I wasn't sure what to use. It was between this and a pair of binoculars, as I have already used binoculars for an icon, I decided to use the magnifying glass.

Nearby:

This icon is supposed to correspond to the icon used for Location. For this reason, I have used it for the nearby icon. The nearby section will be used to view the birds that are close to you. Picking an icon for this was difficult as there aren't very many available options when thinking of an icon for things that are nearby. Whilst this icon could be used for other sections such as logging a sighting, I feel like it is suitable for the nearby icon.

Library:

For this icon, I was stuck between creating a book or a nest. This is where you will be able to view all birds in the database. Now, I feel like the book is the best icon available, however this might change later.

These are all the icons and colour schemes that I have available now. As with a lot of the project, there may be changes at later stages. I also haven't thought about the integration between these icons and the ones that will be used for the website. This is something that will be updated later. I aim to keep the same colour scheme for the website and aim to keep the simplicity.

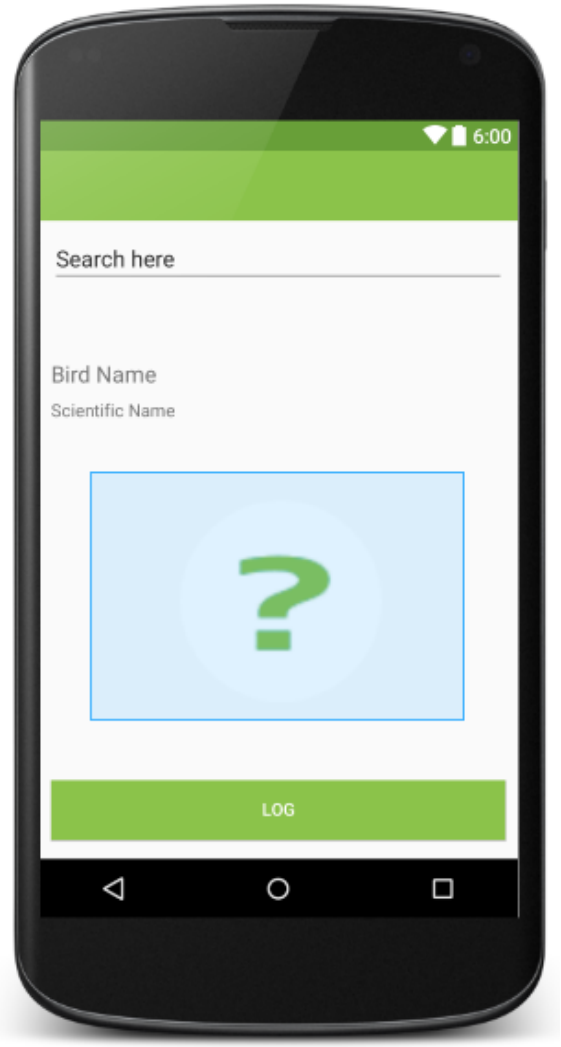
Reference list:

1. Johnson, D., (nd). *Color Psychology*. Available at: http://www.infoplease.com/spot/colors1.html (Accessed on 05/02/17)

Appendix I: Android Application Designs in Android Studios

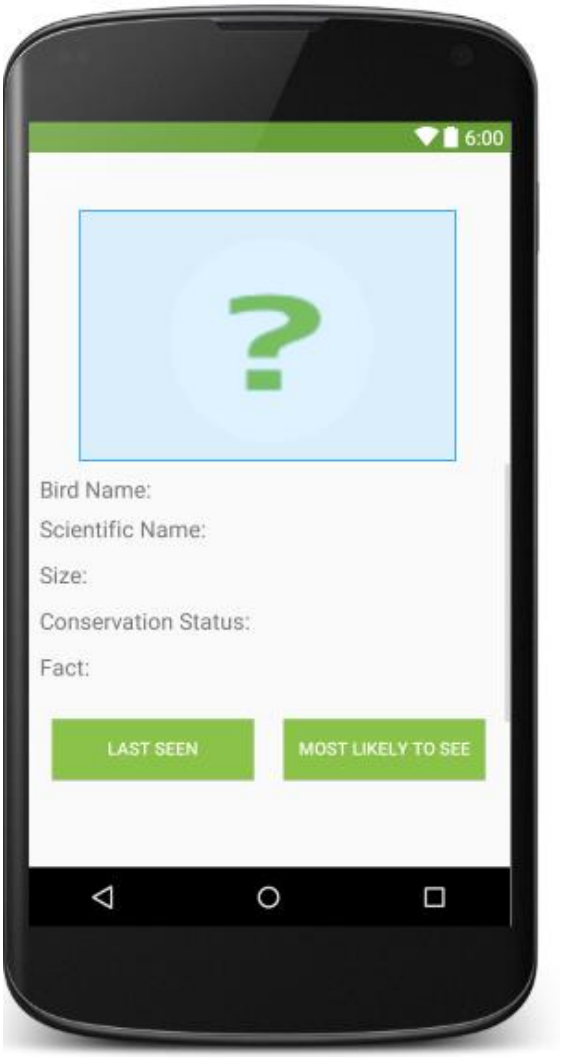
As I finished the work that I set myself to do this week earlier than anticipated. I have decided to create the designs in Android studio. I have attached each individual screen below with a small annotation below each screenshot.

Log a sighting



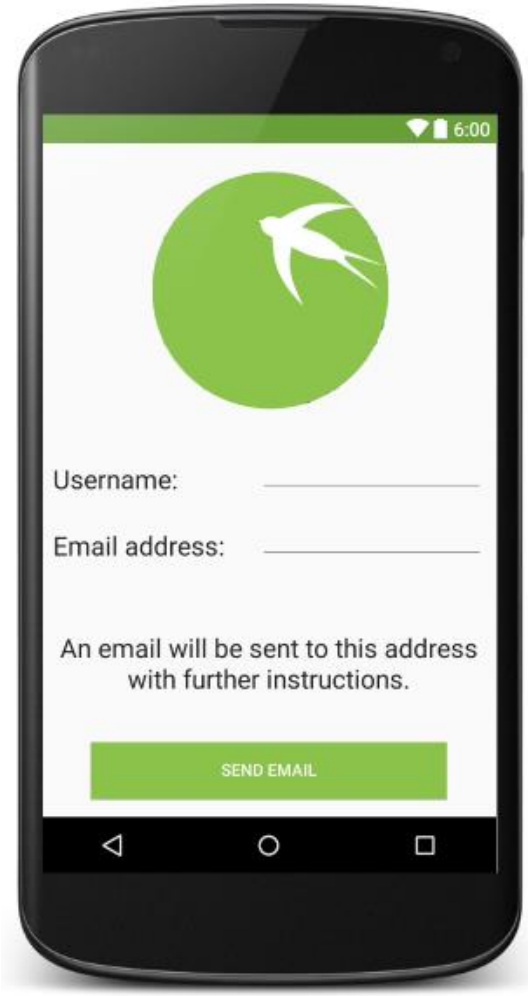
After logging in to the system, this is the first screen that you will see. The screen looks slightly off at the moment as there is no actual data in the application. When the application has been loaded with data, you will be able to search in the search bar at the top. When you have entered the name of the bird you are looking for and pressed enter, you will see the name and scientific name of the bird as well as a picture. Then you simply need to press the log button and a toast pop up will confirm your sighting. The screen will then default back to the view above.

View information about a bird



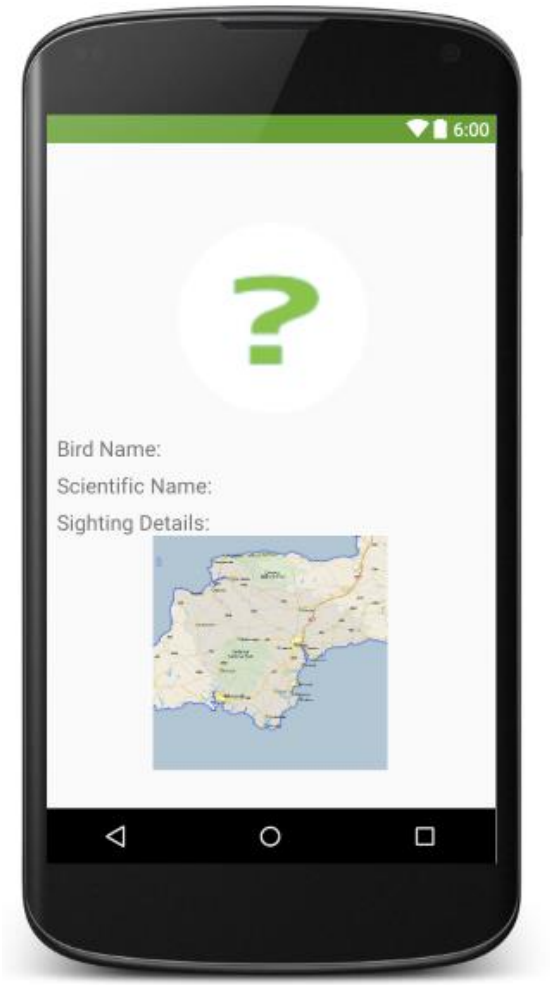
Again, this screen will look slightly different when populated with data. Beneath the picture is a scroll view. I haven't decided whether the buttons will be included in this scroll view yet. I'm not sure whether it will look better with them being static. The scroll view is necessary because the fact about the bird is likely to be quite long. This screen will also include the App Bar. This appears to be something that I missed off this screen, however it is something that will be included.

Forgot password



This is the screen that you will see if you have forgotten your password. I haven't entirely decided / worked out how this will work at the moment. However I feel like it is a crucial feature to have in some variation. For all of the initial screens before you login, you will see a plain white background with the logo at the top.

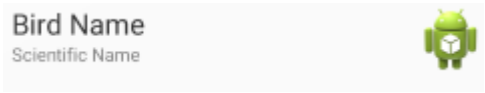
Last seen information



This screen is one that is going to change the most when the data is populated. The image at the bottom of the screen will be replaced by the Google Maps API and the question mark at the top will be changed to an image of the bird in question. I have already received my Google Maps API key, so it is just a question of implementation now. Again, this screen will have the App Bar implemented. I believe I missed it off by mistake.

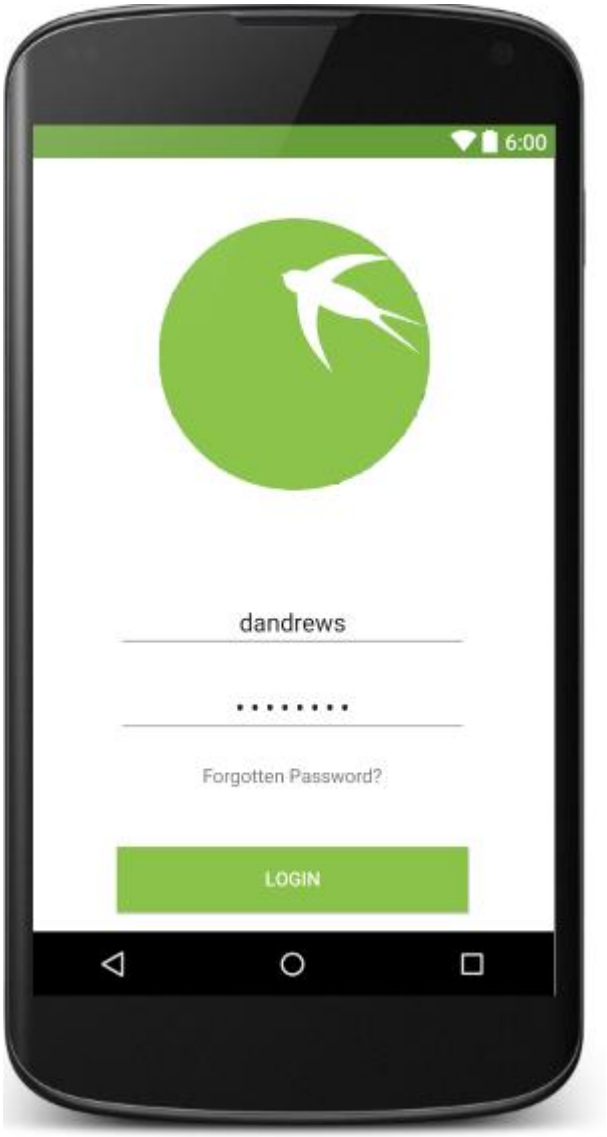
Library

This is another screen that is going to look very different upon the data being added. I have included an example of what each row will look like below. Each item is stored in a scroll view and you can search for the name of the bird at the top of the page.



This is the custom row. As you can see, each record will show the birds name, scientific name and a small image of the bird for identification purposes.

Login screen

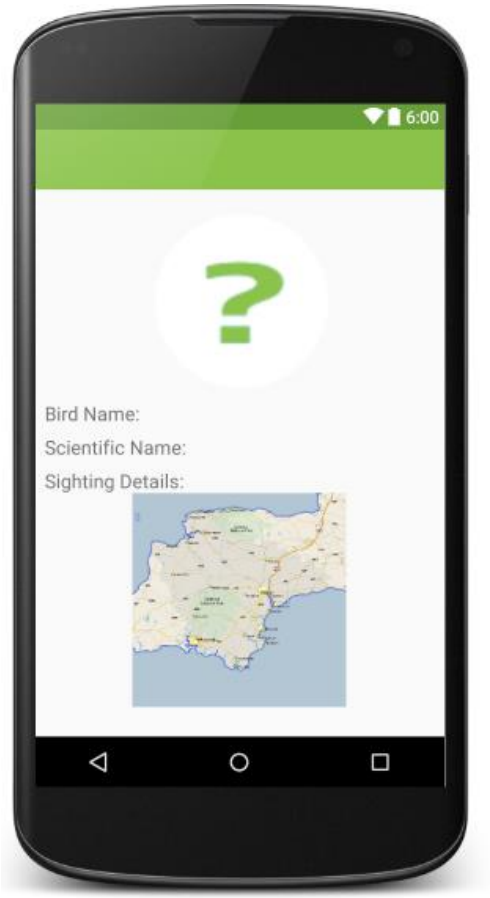


This is the login screen. It looks very similar to the forgotten password screen. As you can see you are given the opportunity to enter your username and password as well as selecting the forgotten password option. If you enter your credentials incorrectly you will be prompted with a toast message to enter your credentials again. I think I will have it so that the username is stored and you only have to enter the password again.

First screen you see

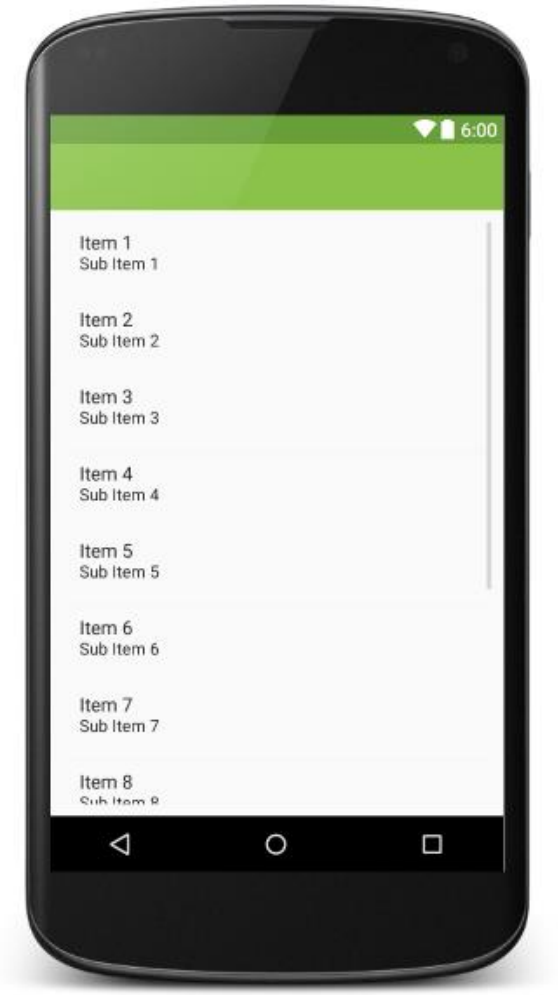
This is the very first screen that you will see when you use the application. There are three options available. Login, this takes you to the login page. Register, this will take you to the register page. After registering you will be logged in. The third option is to continue as guest. If you continue as a guest you won't have the option to log your own data or view your own sightings. However, you will still be able to view the different birds in the system as well as view where you are likely to see the birds.

Most likely to see



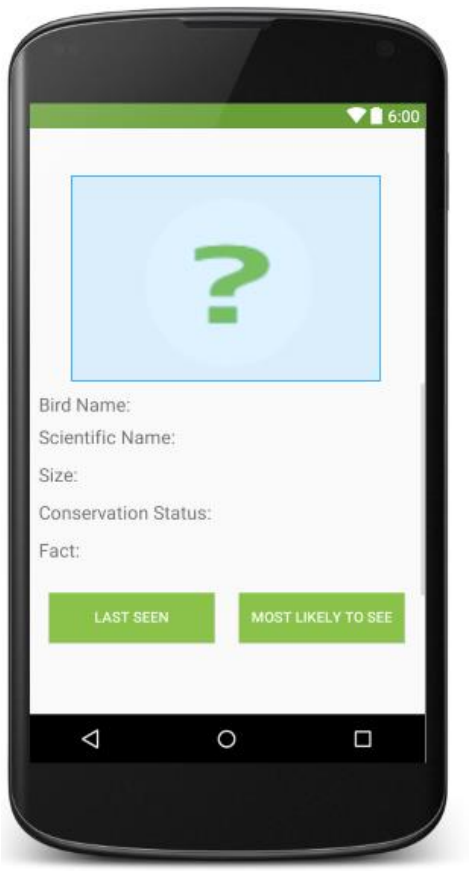
The most likely to see screen is almost identical to the last seen screen. The only difference will be the sighting details.

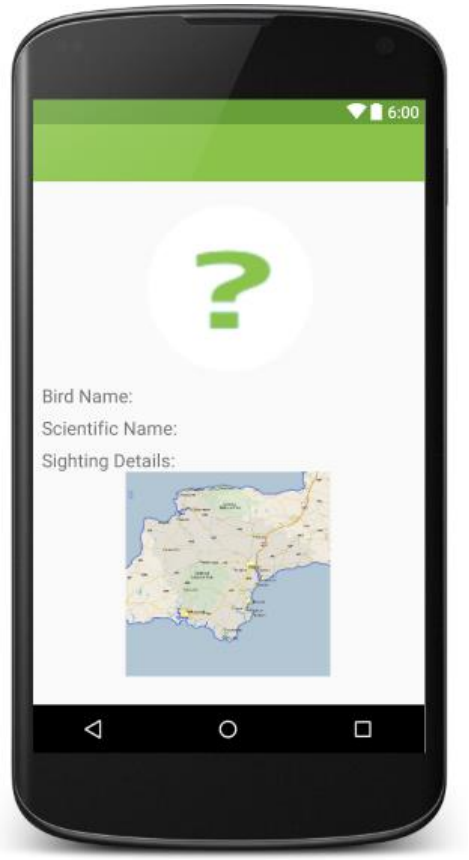
Nearby:



The nearby screen is going to be very similar to the library screen. The only difference will be in the custom rows. Instead of an image of the bird, I think I am going to include how long ago the viewing was logged. This is something that I need to consider in great detail. I also haven't decided in full detail whether clicking on one of these items will take you to the sighting information, or whether it will take you to the information about the bird. Initially I was planning on having it take you to the information about the bird, however I feel that viewing the sighting details would be more crucial.

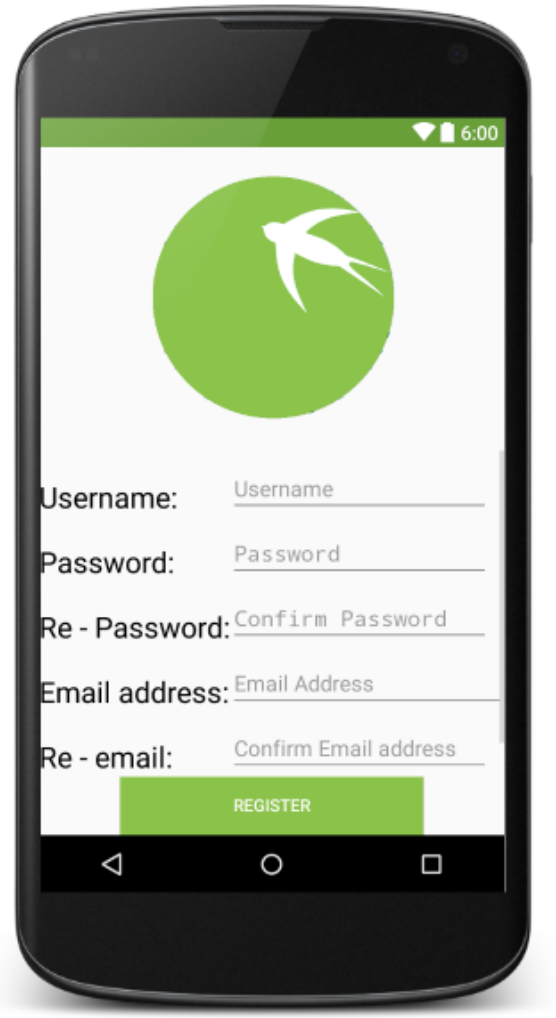
Nearby information





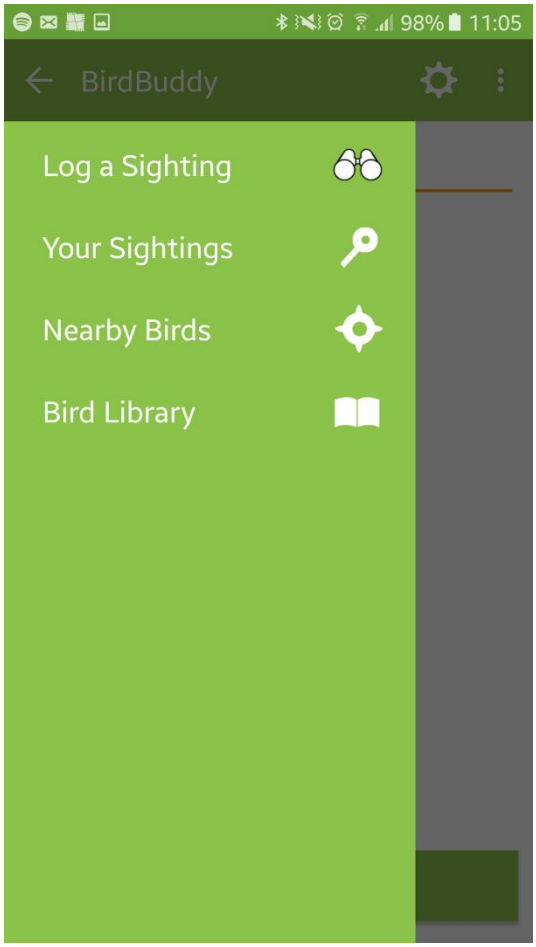
As previously mentioned, when clicking on a row of data in the nearby information, you will be returned with one of the above screens. I haven't decided in full which one I will use yet though.

Register



This is the register screen. When signing up for the system, the user will be prompted to provide a username, password and email address. I have specifically not asked for the users real name for data protection reasons. All of the data entry fields on this page are going to be in a scroll view for ease of access.

Navigation Drawer

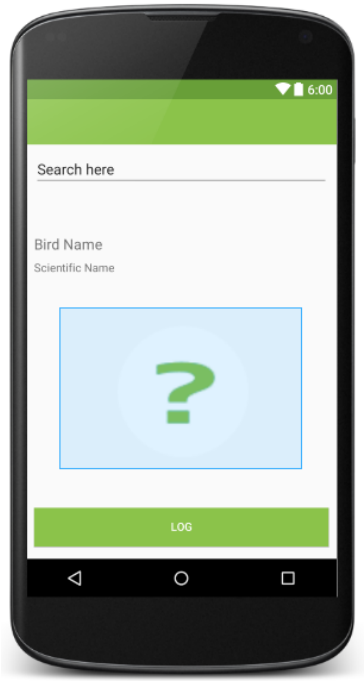


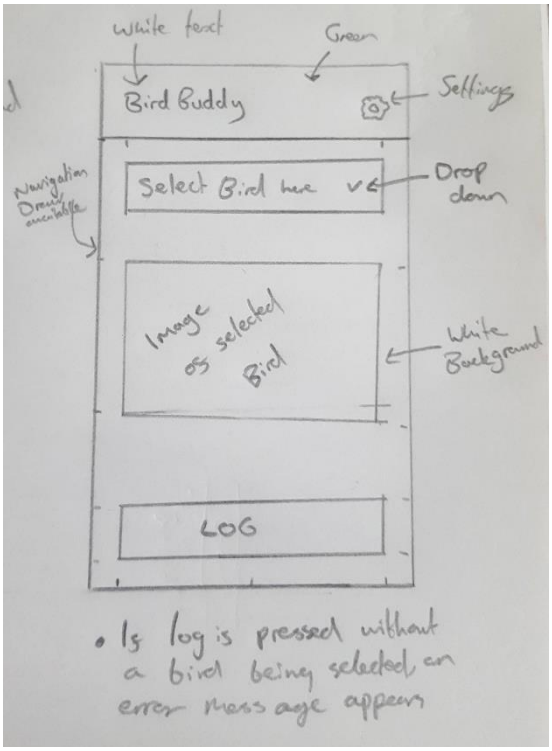
This is the Navigation Drawer in use on my device. As you can see there is currently a lot of space not being utilised. This is something that I am going to look in to further. However I am pleased with the way that it has come out. I have created the logos myself.

Appendix J: Android Designs vs Paper Designs

This document acts as a comparison of my paper based designs and the designs that I have implemented in Android Studio for the actual designs.

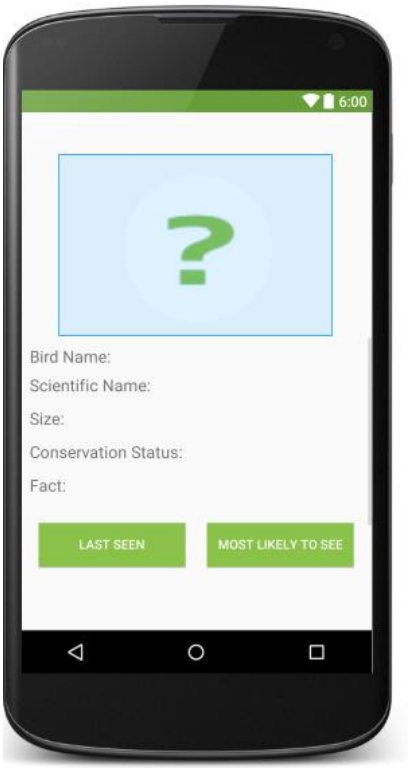
Logging a sighting

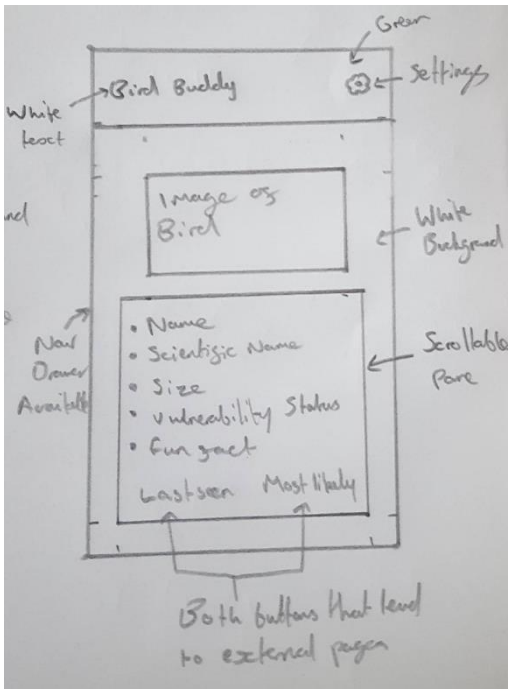




The design for this has stayed almost the same, the only difference has been the addition of the bird name and scientific name after selection.

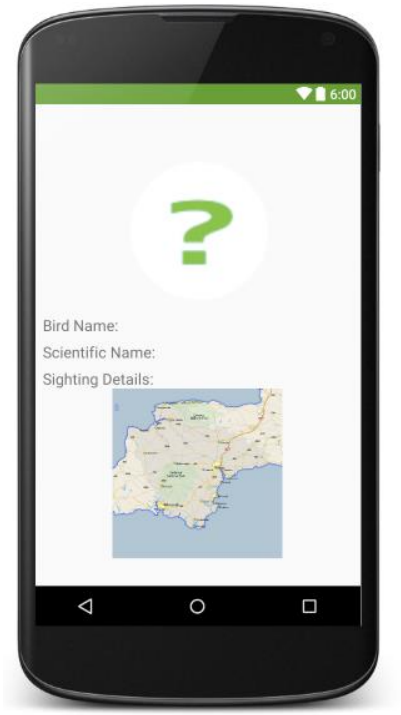
Information about a bird / Nearby information

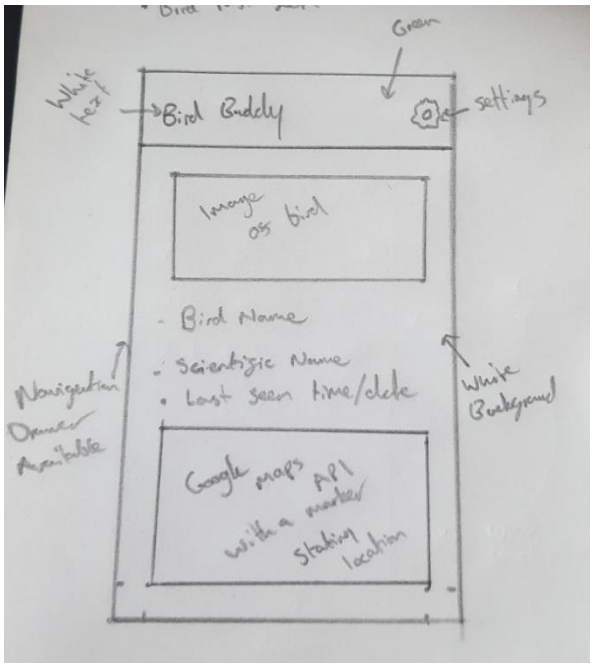




There have been no changed to this screen.

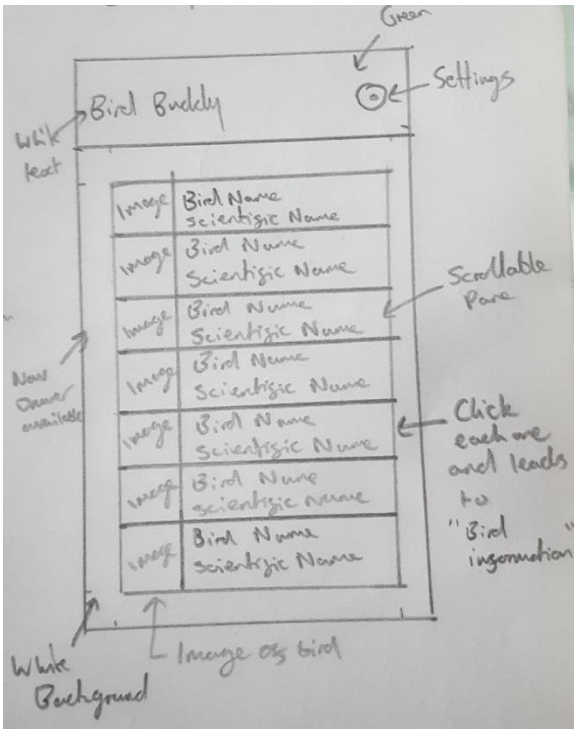
Last seen information / Most likely to see / Nearby information





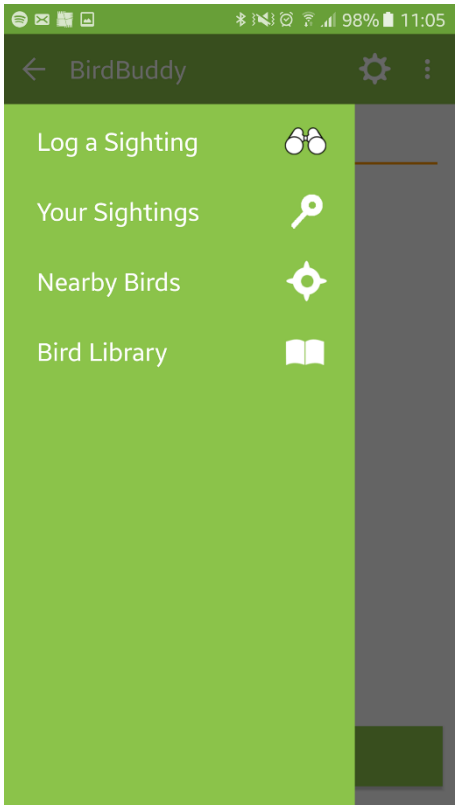
This is another screen that there have been no changes to.

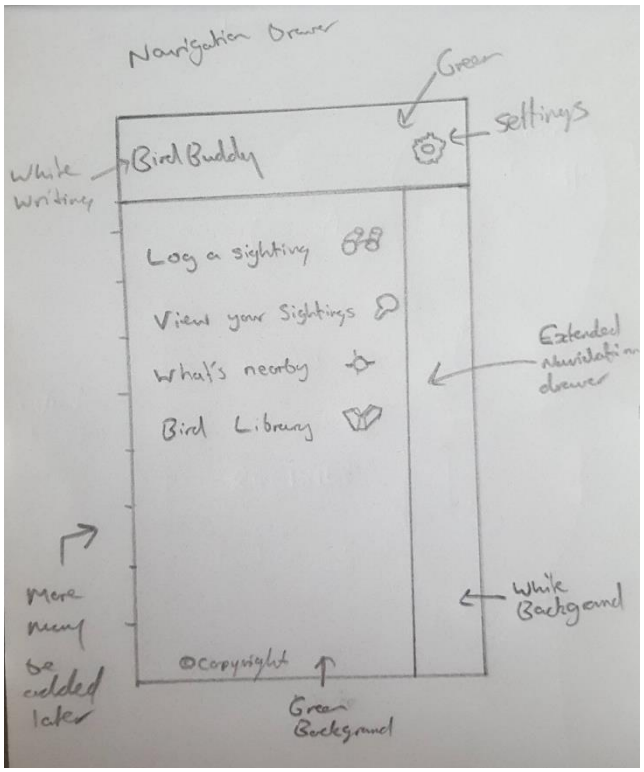
Library / Nearby



The only changes to this design (after implementation of the data), is the positioning of the image. When creating the designs in Android Studio I thought that it may be better suited if the image is on the right, this may change though.

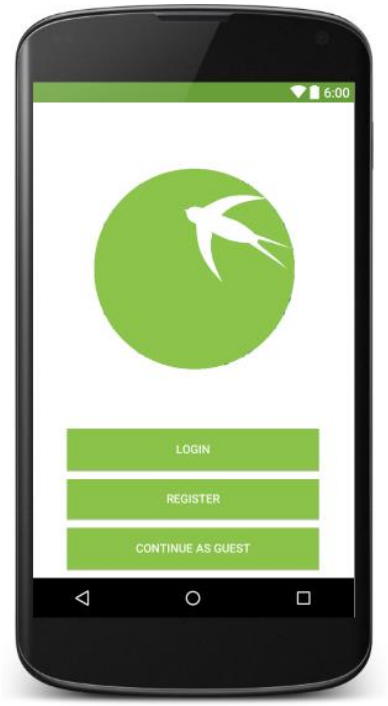
Navigation Drawer

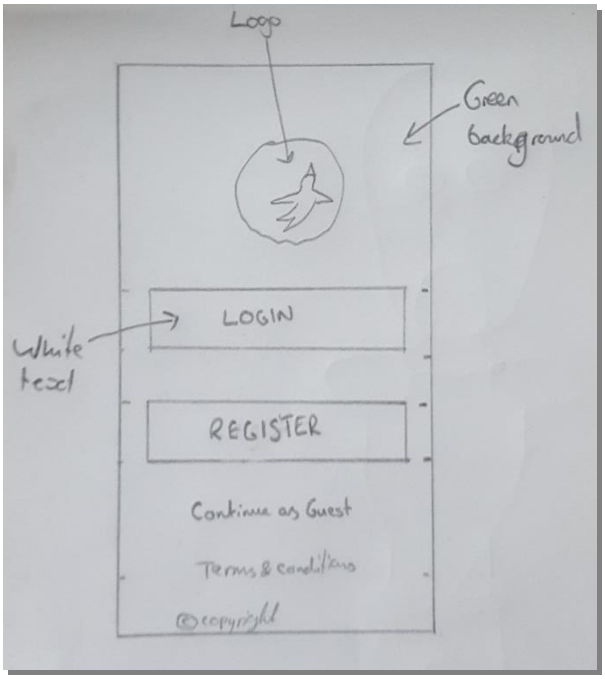




The only real changes that have been to the navigation drawer is the wording used for the different options.

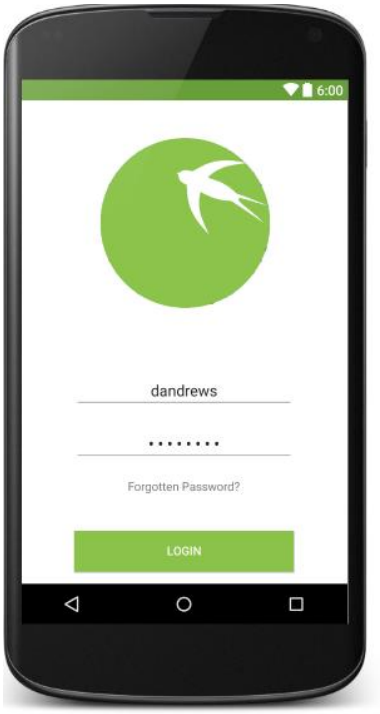
Initial Screen

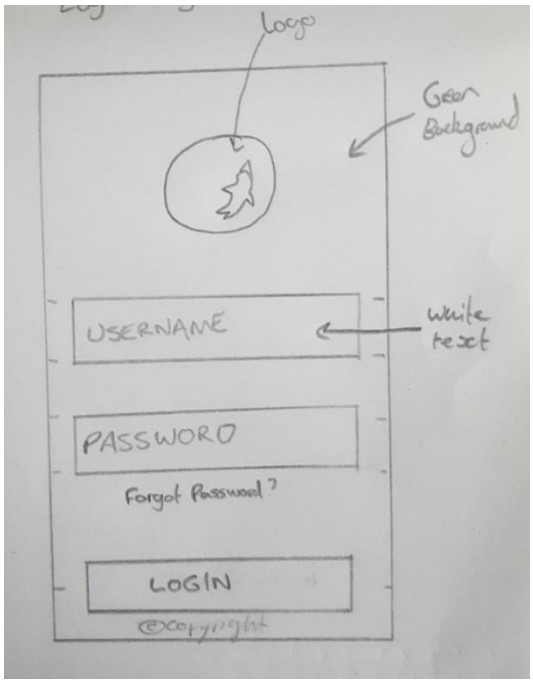




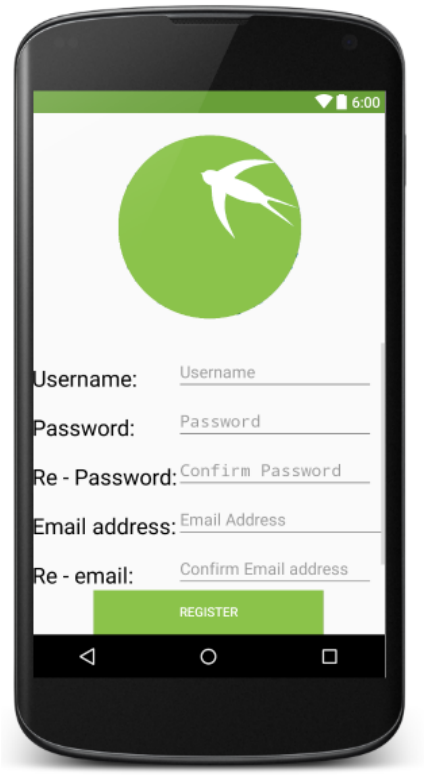
There have been slight changes to the overall design of the initial screen. Most notably the removal of the terms and conditions. I am currently unsure if this will make it in to the application. It may be something that is stored away in the settings menu.

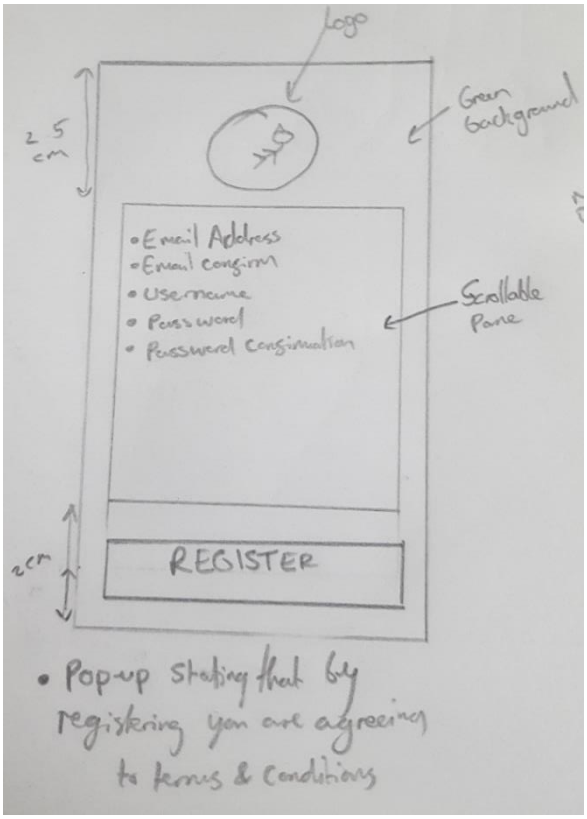
Login





Register





The Register screen has stayed the same, there may be slight changes made to the overall design though. I am currently unhappy with the padding on the left of the scroll view.

These are all of the unique designs. There are additional screens available within the application, however they are all variations of the above screens.

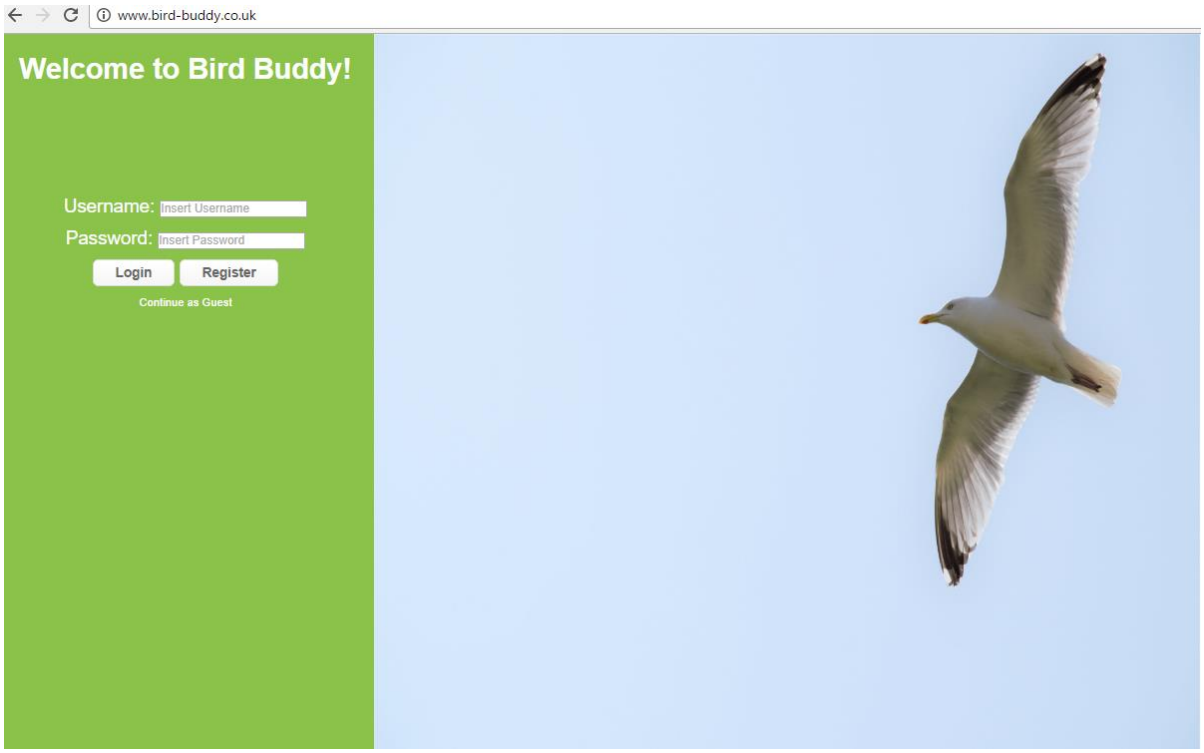
Appendix K: Initial Website compared to designs

Login / Register page

I have currently just finished a prototype for my website. As I didn't complete a full design for the website, I had to think of the design on the go. When creating the website, I wanted to stick to a minimalist approach. The login screen below is the first screen that I developed for the website. When creating this screen, I had the designs for the Android application in mind.

The login screen is the same as the register screen, the only difference is the fields that are shown on the screen. When you register, you are asked to provide an email address twice and a password twice. This is to make sure users enter the correct credentials.

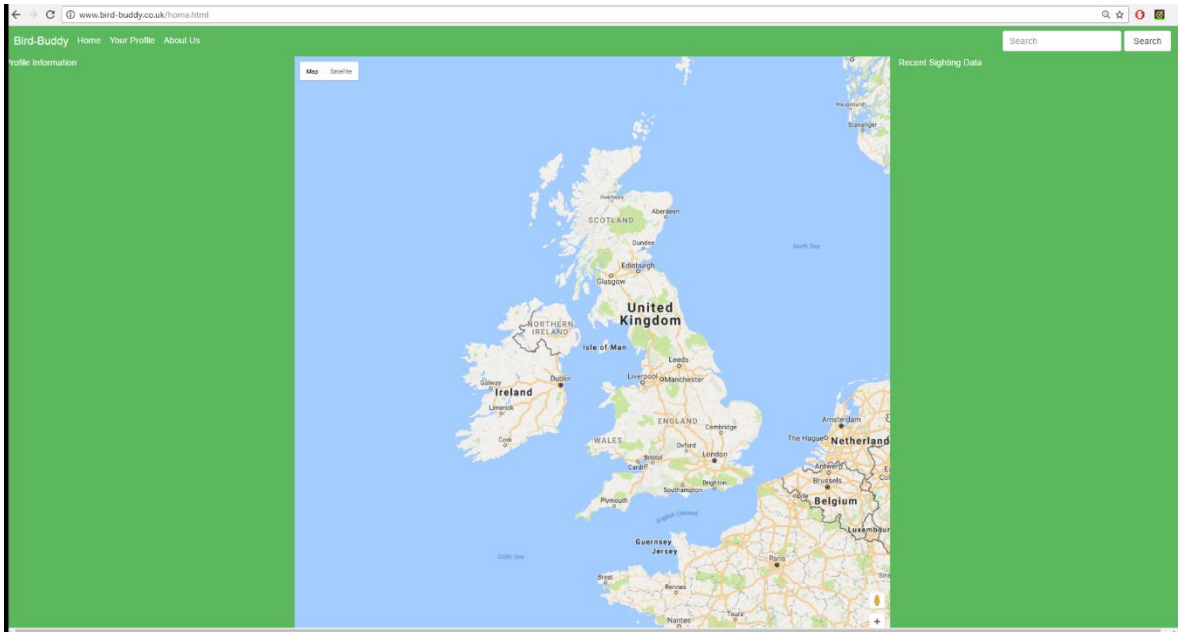
It is my intention to have the background image change between several different images of birds. These images will be taken by myself.



Core Page

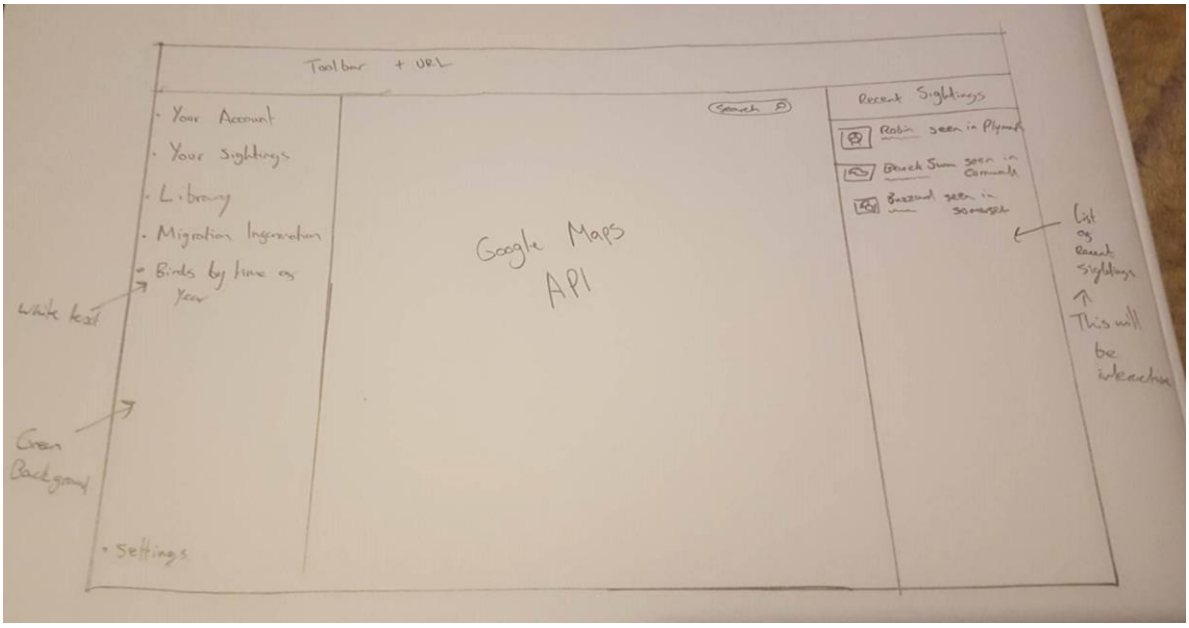
This is the screen that I have created for the main page that you will see as soon as your login. I will make changes to the page throughout the development process. As you can see, the colour is slightly different. This is because I am using a bootstrap theme instead of CSS code on this screen. This might change at a later stage. Whilst the two side panels are currently empty, further in the development process they will store the anticipated information from my paper based design.

This page is going to be the core page that you see throughout the application. The middle panel will be the same, but the information on the left and right panel will change depending on your



request.

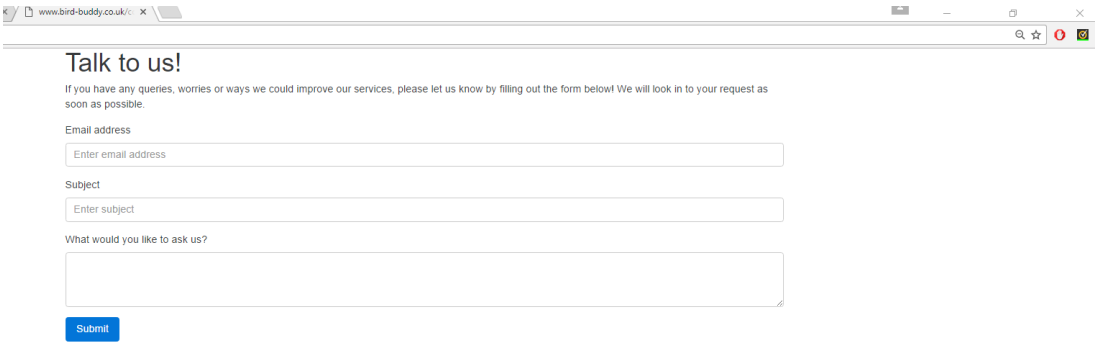
I have included a screenshot below of my paper based design for this screen. The only changes I have made between the initial design and the most recent design is the location of the search box. I feel like the new placement of the search box Is much better suited as it removes blank in the navigation bar. The navigation bar has been designed so that it is constantly at the top of the



screen.

I am likely to make more changes to the designs of the website, this will include the addition of a third type of screen. This screen will be suited towards the support for users. I have created a

very basic template below for what this screen is likely to look like. It is also worth noting that this screen is functional and sends me emails whenever the submit button is pressed.



This is the support screen, this will be a similar screen to when a user wishes to change their credentials or wishes to report a sighting. As with all the other screenshots, this is likely to change at a later stage.

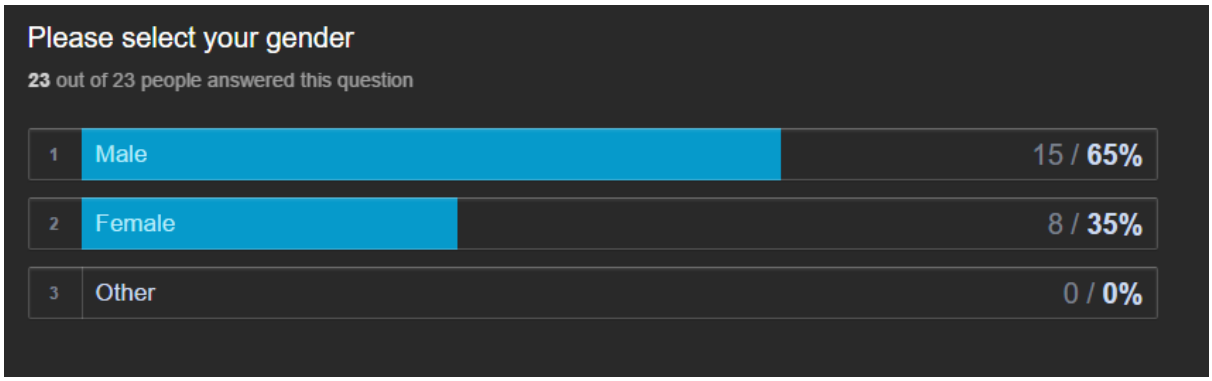
Appendix L: User Testing Survey

Short Survey:

1.- Please select your gender	2.- Please select your age group.	3.- Which mobile operating sys...	4.- Do you have an interest in B...	5.- If yes, how frequently do yo...	6.- Would you be interested in ...	7.- Please give your reasoning t...
Male	18-24	Android	✔	Every now and then	✔	Bird watching is something that interests me, it would be cool to keep track of what is seen
Male	45-54	Android	✔	Every now and then	✔	It would be more fun than collecting Pokemon
Female	18-24	iOS	✘	Never	✘	I don't really care
Female	18-24	Android	✘	Never	✔	I don't really watch birds, but I think an app for it would be a nice way to add to the hobby. I asume many people in the bird watching community will like it.
Male	45-54	Android	✔	1-2 times a month	✔	Would like to know when and where certain birds are likely to be seen in the future.
Male	Under 18	Android	✔	Never	✔	I have never actually been bird watching , but I have an interest the app may push me to actual do it!
Female	18-24	Android	✔	Every now and then	✔	To check off native birds. Also to help identify them
Male	25-34	Android	✔	Hardly ever	✔	so I can remember
Male	18-24	Android	✘	Never	✘	I like squirles
Male	25-34	iOS	✔	Every Week	✔	Many bird identification apps have a section to track sightings, but since it's not the main purpose of the apps they are often unorganized and not very useful, I would be interested in a standalone app dedicated only to recording sightings.
Male	Under 18	Android	✘	Never	✔	It would be really cool to see what birds I have seen and haven't seen. It may even help me to start going out to find birds that I haven't seen before.
Female	25-34	iOS	✔	Every Week	✔	if an app helped identify unusual birds AND kept track that would be good but there are already apps like this on the market
Male	35-44	Android	✘	Never	✘	I don't even use mobile apps for the hobbies I participate in.
Male	25-34	Android	✔	1-2 times a month	✔	I've been gifted bird recording journals in the past and have put them to use, despite wanting to record what birds I see. I always have my phone handy, and have considered the most effective way to track
Male	18-24	iOS	✘	Never	✘	I don't bird watch
Male	18-24	Android	✘	Never	✔	For statistics
Male	18-24	Android	✔	Every now and then	✔	
Female	25-34	Android	✘	Never	✘	
Female	25-34	Android	✔	Every now and then	✔	It would be interesting and I'm too lazy to write things down
Female	Under 18	iOS	✘	Never	✘	I dont watch birds, if I did tho i think itd be useful
Male	55-64	Windows	✔	Every now and then	✘	Enjoy looking on a less than serious nature. Would use Internet Explorer if needed help
Female	45-54	Android	✔	1-2 times a month	✔	So I could try to find them and take photos
Male	45-54	iOS	✔	Every now and then	✔	Always good to be able to record location, not just the species.

Between the second and third of February I created a short survey to get some market research as to who is likely to use my project if it were to be released after this module. This also helped me to gauge how the application and website should be designed. For example, if the application is going to be used mostly by older people that haven't grown up using smartphones, the app should be easy to run through or have sufficient guidance as to how to use the application. In this survey, I asked a total of seven questions. In the first 24 hours that the survey was up, I had a total of 23 responses. If there appears to be another spike in people completing the survey the results may be reuploaded. The questions are as follows.

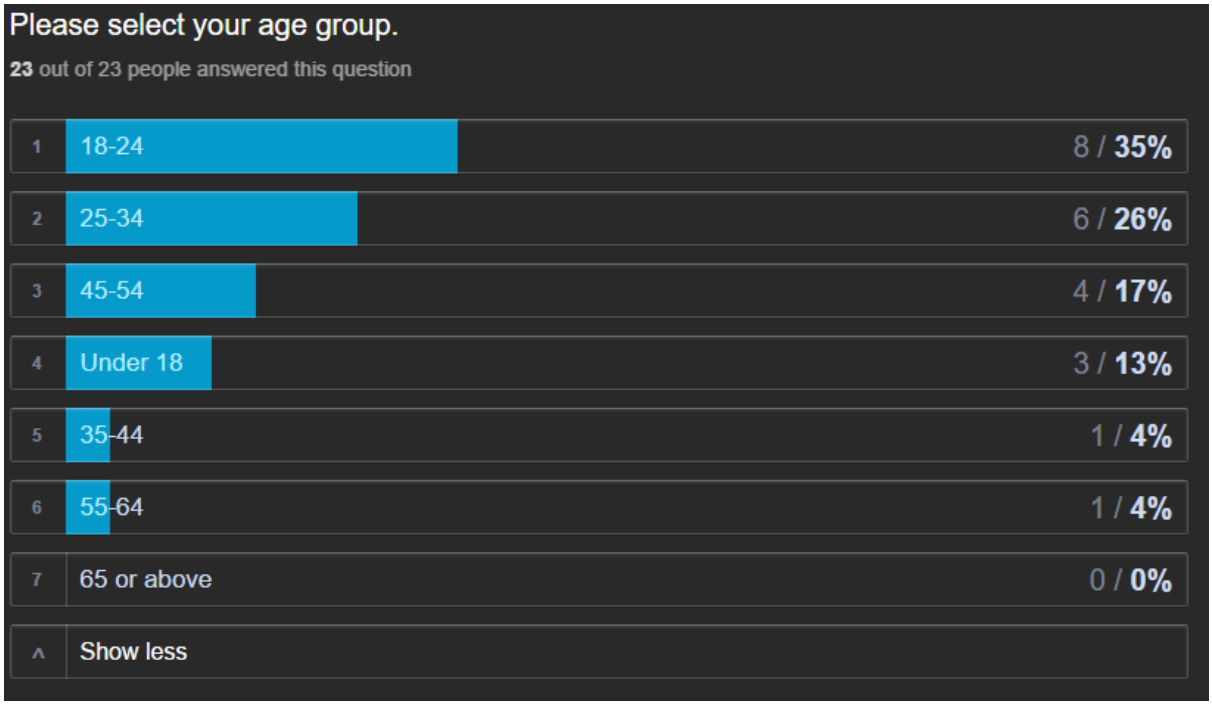
Question 1:



This shows us that there were significantly more male respondents. This could be due to the nature of the sites that the survey was posted. My survey was shared on two sub-reddits. These include /r/birds and /r/SampleSize. The first sub-reddit is aimed at people with an interest in bird

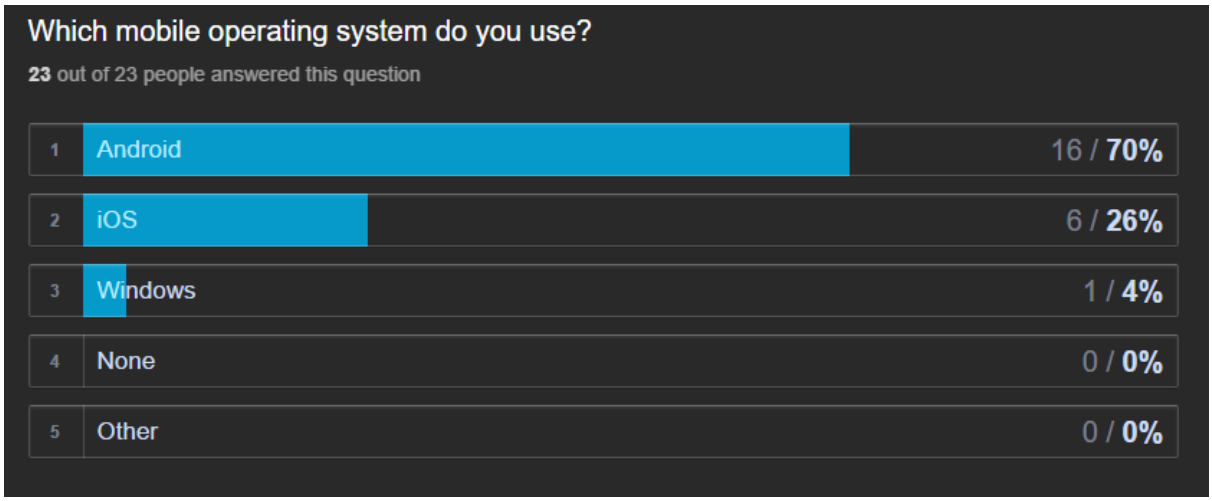
watching and pictures of birds. The latter is a sub-reddit dedicated to research, anyone can post their surveys and a wide number of people can respond if they wish.

Question 2:



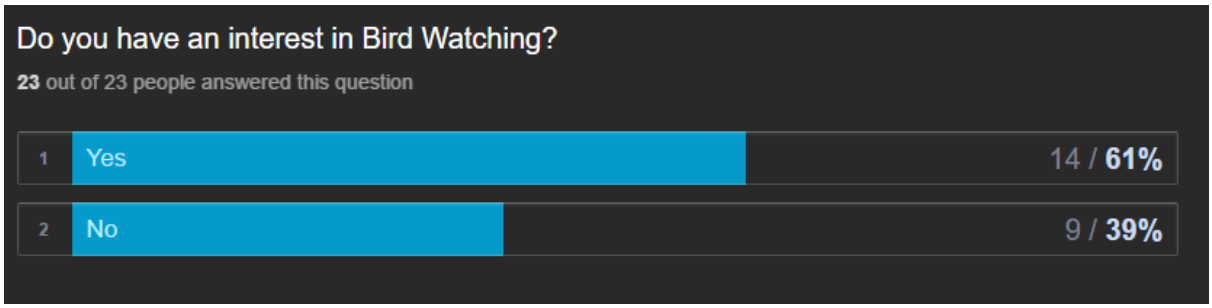
Again, the results here could be due to the nature of where the survey was posted. I made sure not to share the survey on any of my personal social media accounts such as Facebook as this would have swayed the results to predominantly be users between the ages of 18 and 24, this would be due to the fact that most of my friends on Facebook are within this age range.

Question 3:



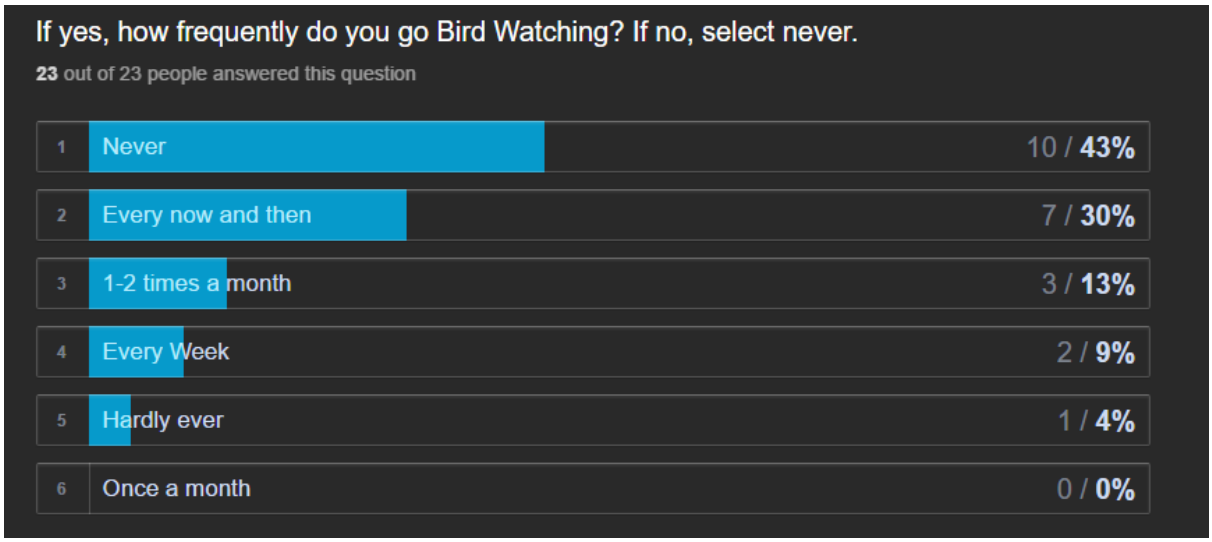
The results here show me that selecting Android as the platform appears to be a good choice. However, this information is not very useful. To make this more useful, I would need to know whether the users of these devices would be likely to use the application. This will be addressed later.

Question 4:



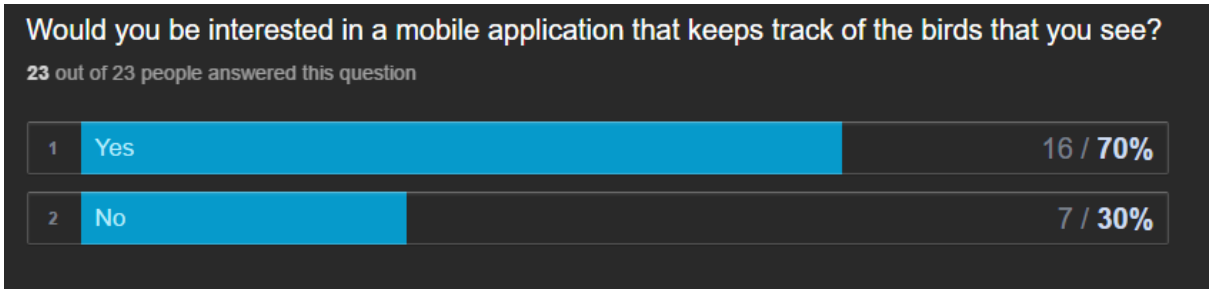
I selected this question to ensure the people completing the survey have an interest in the area. The answers to this could be slightly biased however, this is because I posted the survey to what is essentially a bird watching forum. This is however what I needed to know.

Question 5:



This question doesn't return too much information for analysis. It is just in place to get a gauge as to how often the application is likely to be used.

Question 6:



This is by far the most important question in the survey. It shows the percentage of people that would be interested in the application. It is worth noting that there is also a seventh question, this question is essentially asking for the reasons to the above question. In this additional question, I received a lot of information about what the users would be interested in in such an application. Most of the responses I received were positive. On the following page, there is a list of the useful answers from the survey to this question.

Answers to question 7:

- "Bird watching is something that interests me, it would be cool to keep track of what is seen"
- "I don't really watch birds, but I think an app for it would be a nice way to add to the hobby. I assume many people in the bird watching community will like it."
- "Would like to know when and where certain birds are likely to be seen in the future."
- "I have never actually been bird watching, but I have an interest. The app may push me to actually do it!"
- "for statistics"
- "It would be interesting and I'm too lazy to write things down"
- "I don't watch birds, If I did though I think it'd be useful"
- "Always good to be able to record location, not just the species"
- "So I could try to find them and take photos"
- "If an app helped identify unusual birds AND kept track that would be good. But there are already apps like this on the market."
- "It would be really cool to see what birds I have and haven't seen. It may even help me to start going out to find birds that I haven't seen before."
- "I've been gifted bird recording journals in the past and have put them to use, despite wanting to record what birds I see. I always have my phone handy, and have considered the most effective way to track."
- Many bird identification apps have a section to track sightings, but since it's not the main purpose of the apps, they are often unorganized and not very useful. I would be interested in a standalone app dedicated only to recording sightings."

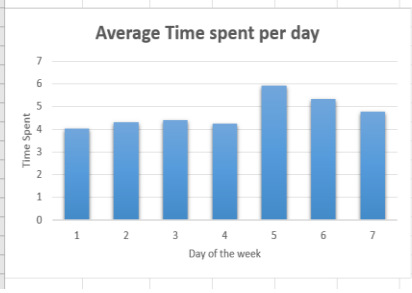
Useful statistics:

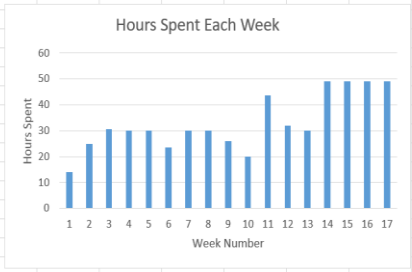
- Of the 16 responses that were Android users, 13 of them would be interested in an Android application that keeps track of the birds that they see. This is equivalent to roughly 81%
- 12.5% of the people that were interested in the application were under 18.
- 31.25% of the people that were interested in the application were between 18 and 24
- 31.5% of the people that were interested in the application were between 25 and 34
- 25% of the people that were interested in the application were between 45 and 54

This information shows me that there is no one specific target audience for this application. For this reason, the application should have easy navigation features, with support available when necessary.

Appendix M: Hours Spent

Week	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Average
Monday	2	0	0	5	1	0	5	4	3.5	0	6	8	6	7	7	7	7	4.029412
Tuesday	2	0	2	5	0	2	5	5	4.5	0	7	7	6	7	7	7	7	4.323529
Wednesday	2	4	5.5	3	3	5.5	0	5	0	5	6.75	7	0	7	7	7	7	4.397059
Thursday	2	5	4	0	6.5	5	5	0	4.5	0	7	5	0	7	7	7	7	4.235294
Friday	2	6	7	5.5	5.5	7	5	6	6	5	8.5	5	4	7	7	7	0	5.911765
Saturday	2	5	6	5.5	9	2	5	5	4.5	5	6.5	0	7	7	7	7	0	5.323529
Sunday	2	5	6	6	5	2	5	5	3	5	2	0	7	7	7	7	0	4.764706
Hours a week	14	25	30.5	30	30	23.5	30	30	26	20	43.75	32	30	49	49	49	28	32.98529
Total:	14	39	69.5	99.5	129.5	153	183	213	239	259	302.75	334.75	364.75	413.75	462.8	511.75	539.75	
Overall	560.75																	





Week 0 is time spent on the project before the official beginning of Semester 2. This includes the creation of the PID.

Appendix N: Ethics Form

PLYMOUTH UNIVERSITY FACULTY OF SCIENCE AND ENGINEERING

Research Ethics Committee

APPLICATION FOR ETHICAL APPROVAL OF RESEARCH INVOLVING HUMAN PARTICIPANTS

All applicants should read the guidelines which are available via the following link:

https://staff.plymouth.ac.uk//scienv/humanethics/intranet.htm

This is a WORD document. Please complete in WORD and extend space where necessary.

*All applications must be word processed. Handwritten applications **will** be returned.*

Please submit with interview schedules and/or questionnaires appropriately.

Postgraduate and Staff must submit a signed copy to SciEngHumanEthics@plymouth.ac.uk

Undergraduate students should contact their School Representative of the Science and Engineering Research Ethics Committee or dissertation advisor prior to completing this form to confirm the process within their School.

***School of Computing, Electronics and Mathematics undergraduate students** – please submit to SciEngHumanEthics@plymouth.ac.uk with your project supervisor copied in.*

---

1. TYPE OF PROJECT

1.1 What is the type of project? (Put an X next to one only)

STAFF should put an X next to one of the three options below:

Specific project

Thematic programme of research

Practical / Laboratory Class

.

1.2 Put an X next to one only

POSTGRADUATE STUDENTS should put an X next to one of the options below:

Taught Masters Project

M.Phil / PhD by research

UNDERGRADUATE STUDENTS should put an X next to one of the options below:

Student research project **X**

Practical / Laboratory class where you are acting as the experimenter

2. APPLICATION

2.1 TITLE of Research project
Bird Buddy – PRCO304 Final Project
2.2 General summary of the proposed research for which ethical clearance is sought, briefly outlining the aims and objectives and providing details of interventions/procedures involving participants (no jargon)
AIM: Evaluation of the usability of a self-developed Android Application and Website for my final year project. Method:

I will give a select number of adults a sheet of tasks that I would like them to complete and access to the application / website. I will be sitting with them whilst they complete the challenges.

I will create a list of tasks that I would like the users to complete and provide a secondary sheet for the users to give me feedback. On this secondary sheet, I will have some predetermined questions ready such as “How easy was it to log a sighting?” and “Did you have any problems accessing your profile?”

I will be recording the audio whilst the users run through the application / website to keep note of anything that they may say that will help me to improve the interface.

2.3 Physical site(s) where research will be carried out

Babbage Building,	50 Redstart Road,
Drake Circus,	Chard,
Plymouth,	Somerset,
Pl4 8AA	TA20 1SD

2.4 External Institutions involved in the research (e.g. other university, hospital, prison etc.)

None

2.5 Name, telephone number, e-mail address and position of lead person for this project (plus full details of Project Supervisor if applicable)

Project Lead:

Name: Daniel Andrews

Email: Daniel.Andrews@students.plymouth.ac.uk

Position: Undergraduate Student

Project Supervisor:

Dr Nigel Barlow

Associate Professor (Senior Lecturer)

University of Plymouth

B313 Portland Square,

Drake Circus,

Plymouth, PL4 8AA Phone: 01752 586208 Email: nigel.barlow@plymouth.ac.uk
2.6 Start and end date for research for which ethical clearance is sought (NB maximum period is 3 years)
Start date: 15/03/2017 **End date: 22/05/2017**
2.7 Has this same project received ethical approval from another Ethics Committee?
No
2.8 If yes, do you want Chairman's action?
No
If yes, please include other application and approval letter and STOP HERE. If no, please continue

3. PROCEDURE

3.1 Describe procedures that participants will engage in, Please do not use jargon
The user will be handed a consent form to ensure that they are okay to participate. This form will ensure that they are okay with having the audio recorded for use in this project. The user will be informed that they can still retract their results from being analysed after completing the testing. If the user consents to taking part in the test. They will be presented with multiple questions about the Android Application and the Website. The user will be handed the project leads Samsung Galaxy S6 with the Android Application running. The user will then be asked to login using given credentials. The user will also be asked to access the habitat information for the Golden Eagle. The user will then be asked to log a sighting for a Jackdaw. The final question the user will be asked to logout of the application. The user will then be handed a sheet asking how easy they found it to navigate through the application. The user will then be asked similar questions on the website.
3.2 How long will the procedures take? Give details
The process will take no longer than 30 minutes per person.
3.3 Does your research involve deception?

No
3.4 If yes, please explain why the following conditions apply to your research:
a) Deception is completely unavoidable if the purpose of the research is to be met
b) The research objective has strong scientific merit
c) Any potential harm arising from the proposed deception can be effectively neutralised or reversed by the proposed debriefing procedures (see section below)
3.5 Describe how you will debrief your participants
3.6 Are there any ethical issues (e.g. sensitive material)?
Delete as applicable: **No** **Yes**
3.7 If yes, please explain. You may be asked to provide ethically sensitive material. See also section 11

4. BREAKDOWN OF PARTICIPANTS

4.1 Summary of participants

Type of participant	*Number of participants*
Non-vulnerable Adults	*Between 5 and 10*
Minors (< 16 years)	
Minors (16-18 years)	
Vulnerable Participants *(other than by virtue of being a minor)*	
Other (please specify)	
TOTAL	*Between 5 and 10*

4.2 How were the sample sizes determined?
The larger the number, the longer the testing will take. Having between 5 and 10 test subjects should give me a clear view of what needs to be changed and how users are likely to manoeuvre through the application/ website.
4.3 How will subjects be recruited?
I will be asking several students on my course. This will allow me to get a technical evaluation from likeminded people. I will contact my supervisor to see if he has any people in mind to complete the short test.

Family members and friends of the family. This will allow me to see how normal users would react to the application.
4.4 Will subjects be financially rewarded? If yes, please give details.
No.

5. NON-VULNERABLE ADULTS

5.1 Are some or all of the participants non-vulnerable adults?
Yes
5.2 Inclusion / exclusion criteria
5.3 How will participants give informed consent?
5.4 Consent form(s) attached
Yes
If no, why not?
5.5 Information sheet(s) attached
Delete as applicable: **No** **Yes**
If no, why not?
5.6 How will participants be made aware of their right to withdraw at any time?
The information will be given to them on the consent form. They will also be given a number to contact me in the case that they wish their information to be withdrawn.

5.7 How will confidentiality be maintained, including archiving / destruction of primary data where appropriate, and how will the security of the data be maintained?
I won't ask for any personal information when asking the users to fill out the results from the test. The users will be given a number or a letter, in my evaluation, they will be referred to as such.

6. MINORS <16 YEARS

6.1 Are some or all of the participants under the age of 16?
No
If yes, please consult special guidelines for working with minors. If no, please continue.

6.2 Age range(s) of minors		
6.3 Inclusion / exclusion criteria		
6.4 How will minors give informed consent? Please tick appropriate box and explain (See guidelines)		
Delete as applicable:	**Opt-in**	**Opt-out**
6.5 Consent form(s) for minor attached		
Delete as applicable:	**No**	**Yes**
If no, why not?		
6.6 Information sheet(s) for minor attached		
Delete as applicable:	**No**	**Yes**
If no, why not?		

6.7 Consent form(s) for parent / legal guardian attached
Delete as applicable: **No** **Yes**
If no, why not?
6.8 Information sheet(s) for parent / legal guardian attached
Delete as applicable: **No** **Yes**
If no, why not?
6.9 How will minors be made aware of their right to withdraw at any time?
6.10 How will confidentiality be maintained, including archiving / destruction of primary data where appropriate, and how will the security of the data be maintained?

7. MINORS 16-18 YEARS OLD

7.1 Are some or all of the participants between the ages of 16 and 18?
No
If yes, please consult special guidelines for working with minors. If no, please continue.
7.2 Inclusion / exclusion criteria
7.3 How will minors give informed consent? (See guidelines)

7.4 Consent form(s) for minor attached		
Delete as applicable:	**No**	**Yes**
If no, why not?		
7.5 Information sheet(s) for minor attached		
Delete as applicable:	**No**	**Yes**
If no, why not?		
7.6 Consent form(s) for parent / legal guardian attached		
Delete as applicable:	**No**	**Yes**
If no, why not?		
7.7 Information sheet(s) for parent / legal guardian attached		
Delete as applicable:	**No**	**Yes**
If no, why not?		
7.8 How will minors be made aware of their right to withdraw at any time?		
7.9 How will confidentiality be maintained, including archiving / destruction of primary data where appropriate, and how will the security of the data be maintained?		

8. VULNERABLE GROUPS

8.1 Are some or all of the participants vulnerable? (See guidelines)		
No		
If yes, please consult special guidelines for working with vulnerable groups. If no, please continue.		
8.2 Describe vulnerability (apart from possibly being a minor)		
8.3 Inclusion / exclusion criteria		
8.4 How will participants give informed consent?		
8.5 Consent form(s) for vulnerable person attached		
Delete as applicable:	**No**	**Yes**
If no, why not?		
8.6 Information sheet(s) for vulnerable person attached		
Delete as applicable:	**No**	**Yes**
If no, why not?		
8.7 Consent form(s) for parent / legal guardian attached		
Delete as applicable:	**No**	**Yes**
If no, why not?		
8.8 Information sheet(s) for parent / legal guardian attached		

Delete as applicable: **No** **Yes**
If no, why not?
8.9 How will participants be made aware of their right to withdraw at any time?
8.10 How will confidentiality be maintained, including archiving / destruction of primary data where appropriate, and how will the security of the data be maintained?

9. EXTERNAL CLEARANCES

Investigators working with children and vulnerable adults legally require clearance from the Disclosure and Barring Service (DBS)

9.1 Do ALL experimenters in contact with children and vulnerable adults have <u>current</u> DBS clearance? Please include photocopies.
Delete as applicable: **N/A**
If no, explain
9.2 If your research involves external institutions (school, social service, prison, hospital etc) please provide cover letter(s) from institutional heads permitting you to carry out research on their clients, and where applicable, on their site(s). Are these included?
Delete as applicable: **N/A**
If not, why not?

10. PHYSICAL RISK ASSESSMENT

10.1 Will participants be at risk of physical harm (e.g. from electrodes, other equipment)? (See guidelines)
No
10.2 If yes, please describe
10.3 What measures have been taken to minimise risk? Include risk assessment proformas which has been signed by the Head of Department
I will be using my own equipment throughout the experiments. The website will be tested on my Microsoft Surface Pro 4, this device is less than 4 months old to date. I have never experienced any issues with my Samsung Galaxy S6 (the phone used for testing).
10.4 How will you handle participants who appear to have been harmed?
All testing will take place where there are multiple people around me. This will make it easy to contact emergency services if necessary.

11. PSYCHOLOGICAL RISK ASSESSMENT

11.1 Will participants be at risk of psychological harm (e.g. viewing explicit or emotionally sensitive material, being stressed, recounting traumatic events)? (See guidelines)
No
11.2 If yes, please describe
11.3 What measures have been taken to minimise risk?
11.4 How will you handle participants who appear to have been harmed?

12. RESEARCH OVER THE INTERNET

12.1 Will research be carried out over the internet?
Yes
12.2 If yes, please explain protocol in detail, explaining how informed consent will be given, right to withdraw maintained, and confidentiality maintained. Give details of how you will guard against abuse by participants or others (see guidelines)
Requirement Validation will be taken in to consideration online. In the results, no personal information will be kept other than age and gender of participants.

13. CONFLICTS OF INTEREST & THIRD PARTY INTERESTS

13.1 Do any of the experimenters have a conflict of interest? (See guidelines)
No
13.2 If yes, please describe
13.3 Are there any third parties involved? (See guidelines)
No
13.4 If yes, please describe
13.5 Do any of the third parties have a conflict of interest?
Delete as applicable: **No** **Yes**
13.6 If yes, please describe

14. ADDITIONAL INFORMATION

14.1 [Optional] Give details of any professional bodies whose ethical policies apply to this research

14.2 [Optional] Please give any additional information that you wish to be considered in this application

15. ETHICAL PROTOCOL & DECLARATION

To the best of our knowledge and belief, this research conforms to the ethical principles laid down by the University of Plymouth and by any professional body specified in section 14 above.

This research conforms to the University's Ethical Principles for Research Involving Human Participants with regard to openness and honesty, protection from harm, right to withdraw, debriefing, confidentiality, and informed consent

Sign below where appropriate:

STAFF / RESEARCH POSTGRADUATES

	Print Name	**Signature**	**Date**
Principal Investigator: _____	_____	_____	
Other researchers: _____	_____	_____	
_____	_____	_____	
_____	_____	_____	

Staff and Research Postgraduates should email the completed and signed copy of this form to Paula Simson.

UG Students

	Print Name	Signature	Date
Student:	DANIEL ANDREWS		03/03/17
Supervisor / Advisor:	Dr NIGEL BARLOW		03/03/17
_____	_____	_____	
_____	_____	_____	

Undergraduate students should pass on the completed and signed copy of this form to their School Representative on the Science and Engineering Human Ethics Committee.

	Signature	Date
School Representative on Science and Engineering Faculty Human Ethics Committee _____		_____

Faculty of Science and Engineering Research Ethics Committee List of School Representatives

School of Geography, Earth and Environmental Sciences	Dr Sanzidur Rahman
	Dr Kim Ward
School of Biological and Marine Sciences	Dr Gillian Glegg (Chair)
	Dr Victor Kuri
School of Biomedical and Healthcare Sciences	Dr David J Price

School of Engineering	Dr Liz Hodgkinson
School of Computing, Electronics & Mathematics	Dr Mark Dixon Dr Yinghui Wei
External Representative	Prof Linda La Velle
Lay Member	Rev. David Evans

Committee Secretary: Mrs Paula Simson
email: paula.simson@plymouth.ac.uk
tel: 01752 584503

Appendix O: User Testing Feedback

After the development of the Android application, I asked 10 Plymouth University students to give me feedback for how they felt about the application and to see if any improvements could be put in place.

Below is a list of the tasks and accumulative feedback.

Task 1: Logging in to the system.

All around, no issues.

Task 2: Log a sighting for a Black Headed Gull

All around, no issues. A few users had an issue with the search functionality only working when you press the search icon. Unfortunately this isn't something that you can change in Android Studio.

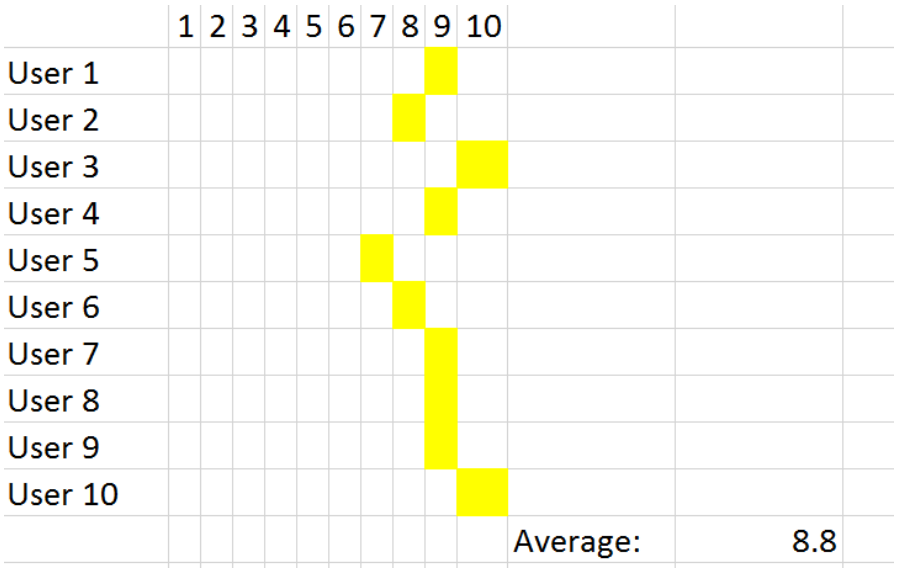
Task 3: Update password

This task hasn't been implemented yet so the users were simply asked to find how you would do so. A lot of users started by looking in the navigation drawer, but after searching through the drawer, they looked in the settings menu.

Task 4: View your sightings and tell me the rough location to the last Golden Eagle.

The users were able to find their sightings and look for the Golden Eagle. Two of the ten users didn't initially realise that you could click on the birds to see the location. I'm not going to change the way this works as it should be self-explanatory.

Scale of 1-10 how easy was it to find the information



Is there anything you would change about the overall design?

Make the sighting screen blank until you have selected a bird to log as a sighting. It could be difficult to tell what to do with a blank page.

A few of the pages need more context. On “What did I see?” You may need to add a bit of information, i.e. you need to press one of the above buttons.

What was your favourite part about the application?

- The navigation drawer makes it really easy to navigate
- Simple design, this won’t make any users feel lost
- I like the idea
- Being able to see the birds in your surrounding area is a good idea

What was your least favourite part about the application?

- Some places need more context
- Bird Sightings isn’t necessarily my sort of thing but I’m sure for people that like bird watching it would be enjoyable

What I intend on doing based on the feedback

- Add context to a few of the screens, e.g. show you what the nearby birds is showing
- Change the logging system so that the screen is blank before you search for a bird.

Appendix P: External Libraries Used

- **Bootstrap 4.0** (Web): Bootstrap is the framework that has been used for my website. It allows the website to be viewed on any device. Whilst I am still only aiming to have the website used on laptops / desktops, resizing is present.

  Accessed from: https://v4-alpha.getbootstrap.com/

- **GenAsync 1.2**: Allows for AsyncTasks with POST variables

  Accessed from: https://github.com/kosalgeek/generic_asynctask

- **Gson 2.2.4**: Converts Java Objects to JSON representations. Developed by Google.

  Accessed from: https://github.com/google/gson

- **KGJsonConverter**: Converts JSON to an array list.

  Accessed from: https://github.com/kosalgeek/KGJsonConverter

- **Universal Image Loader**: An efficient way to load and store images in the Android application. This allows for caching of images for an easier work load on the application.

  Accessed from: https://github.com/nostra13/Android-Universal-Image-Loader

- **Fundapter**: This allows you to create your own adapters that will be used with ListViews. This adapter class allows you to use your own information in the lists.

  Accessed from: https://github.com/amigold/FunDapter

- **Android-upload-service:** This would have been used to upload images to the server. The code can be seen in the android application, but the feature doesn't currently work.

  Accessed from: https://github.com/gotev/android-upload-service/wiki/Setup

All of the above libraries have been used in some form within my Android based application, or the website. The libraries are free to access and can be used within applications published upon the google play store providing credit is given where it is due.

Appendix Q: Changes to Middleware

I had initially anticipated that the middleware would be developed using Java. However, I realised that the server I had chosen for my project didn't support Java or JSP. For this reason, I decided to use PHP to develop the middleware between the database and the Android Application.

What this meant:

This was an initial shock to me as I have had no previous experience in developing using PHP. However, I knew that I would be using PHP on the website, so instead of looking for a new server. I decided to start work on the website, the work that I completed on the website would have been completed later in the development process. However, I used this to my advantage. I could test all the scripts as I created them on the web to ensure that they worked.

The scripts created for the web and Android all slightly differed so I ended up creating two separate scripts for each functionality point. However, as most of the functionality is shared, this wasn't a massive issue. This also helped me to develop the website a lot quicker.

At this current point, based on my plan I am behind. However, this isn't taking in to consideration the completion of the website functionality. So realistically, I am still on target.

Integration with Android:

Implementing the scripts created with my Android application was a lot easier than anticipated, this is because I didn't really know what to expect with PHP and Android as I have never used PHP before. The integration process was very simple and easy to pick up. The only issues that I have experienced so far have been client side, not server side.

Going forward:

In the future, I know now that it is crucial to check which languages are supported by a server. This would have avoided this issue completely. On the other hand, by using PHP for the middleware in my app has meant that I have been able to develop the website a lot earlier than anticipated. I am hoping that this will save me time later in the project.

Appendix R: Database Options

It is no surprise that there are many different options available to users today when looking at selecting a database engine regardless of the purpose. These include: MySQL, PostgreSQL, SQL Server, SQLite and NoSQL databases. During my time at university I have had access to SQL server and learnt the practical uses of NoSQL databases. I have briefly listed below my thought process when looking at each different database type.

SQLite:

SQLite is a database that has many functions. It can be used for data analysis, websites, file archives and many more. [1] SQLite is not a client/server database. Whilst there are many advantages to using a SQLite database, especially whilst creating Android applications, there are drawbacks that shouldn't be overlooked.

SQLite isn't good for high volume websites or large datasets. Whilst this isn't currently an issue. After the project, has been completed if I decide to further the project this may become an issue. MySQL would be future proofing.

SQLite doesn't allow more than one writer to the database at any one time. Again, this won't be an issue whilst the project is going, but moving forward this will cause multiple issues. Whilst this isn't an issue in most situations, as each write takes milliseconds. There is still a small percentage of a chance that issues will be caused during this time. This small percentage gets drastically higher when there are more users involved as there is a higher chance of data being logged at the same time.

SQLite supports databases up to 140 terabytes, providing you can find a disk this size. The database only runs on a single disk. This makes upgrading a costly task that is also likely to take some time. Whilst it is safe to say that I won't reach this limit in the foreseeable future. I would like to future proof my project.

PostgreSQL:

PostgreSQL is arguably the worlds most advanced open source database. Many large companies use it, these include: Skype, Instagram and NASA. PostgreSQL has advanced features such as when you try and add data to it there are limiting factors compared to MySQL.

After doing research in to the benefits that PostgreSQL offers. Most them would not affect me. One instance of this is altering the tables after creation. In a MySQL database, you would need to completely recreate the table. In PostgreSQL, the table creates the new column and gives it a default value. Whilst this is a nice feature, when my table columns are set in stone. I won't have a need to change them.

Not as popular as MySQL, this makes support for it quite difficult to return relevant responses to issues without paying for support. PostgreSQL also has some performance issues when performing read operations. In this instance, MySQL is often better suited. This directly affects my project as on the website there will be a large number or read operations on the data. [2]

A further issue is often finding a suitable hosting provider for PostgreSQL databases. For my project, I can also see PostgreSQL being slightly overkill. For my project, I will not need the complete ACID compliance that PostgreSQL offers as well as a few additional features. Whilst this is something that I may require in the future, having a database structure that is overly complex will provide complications in my project that may take a lot of time to handle.

MySQL:

MySQL is the most popular choice for relational database servers. It is an open-source system that is used in many websites and web applications. Due to the popularity of the database, there is a lot of help available online.

MySQL is easy to install and there are many third-party tools available. The database is scalable and there are a lot of security features within MySQL that can be used.

As previously stated, other databases offer more functionality. However, this is not something that will affect me drastically. As this is a database that I haven't used before, it is likely that I may need some assistance when parsing the data to the android client and website. For this reason, I feel like MySQL will provide me with a lot of available options to look at.

One of the main highlights that I have found whilst researching the database that I am going to use is the assurance of uptime that is offered with MySQL databases. [3] MySQL also offers HA solutions such as master / slave configurations. When moving forward with the project this could be crucial in looking at scaling. Whilst this is not something that I will need to look in to for a long time, it is nice to know that the option is available to me.

There are disadvantages to MySQL however. The main disadvantage that can be seen is that it is owned by Oracle. Oracle acquired the company that created MySQL. [4] This gives Oracle the ability to completely remove MySQL if it so chooses as MySQL could be a competitor to Oracle. This is just a risk that I must take.

NoSQL:

NoSQL is the newest type of database on this list. There are four different types of NoSQL database, each has its own advantages and drawbacks. This brings a level of complexity when looking at which type of database to choose. Fortunately, in my final year I enrolled on the ISAD 353 module. This has given me an intermediate knowledge of the different NoSQL databases and where they should be used.

Whilst there are many advantages that can be achieved when using NoSQL databases. There is very little support available for Android development. This would limit my implementation of a NoSQL database greatly. For this reason, I won't be using a NoSQL database.

SQL Server:

SQL Server is arguably another good choice when it comes to developing databases. And whilst the service would usually be a paid subscription. Students can receive access to the software for free. Whilst this would be an advantage right now. soon, this will be an issue for me.

SQL Server is not open source. This could be an advantage as there is a reduced risk for potential attacks on the server. [5] There is also reputable restoration and recovery techniques in place to recover lost data. These are of course expected from a paid service.

There is also a layer of complexity in selecting an edition of the software. As Microsoft aims to cater for as many different customers as possible, there are multiple tiers available. This makes the decision process slightly more complicated.

SQL Server offers the best security there is and offers a lot of useful features. However, for what I need to use I feel like a MySQL database fulfils my requirements. One of the largest disadvantages that I can see is the expected cost for a license. Whilst this is free is education, if I continue the project I can expect a very large cost for updated versions of this software.

Reference List:

1. SQLite., (ND). Available at: http://www.sqlite.org/whentouse.html (Accessed on: 12/02/2017)
2. DigitalOcean., (2014) Available at: https://www.digitalocean.com/community/tutorials/sqlite-vs-mysql-vs-postgresql-a-comparison-of-relational-database-management-systems (Accessed on 12/02/2017)
3. Branson, T., (2016). Available at: http://www.datamation.com/storage/8-major-advantages-of-using-mysql.html (Accessed on 12/02/2017)
4. Makable., (ND). Available at: http://makble.com/the-advantages-and-disadvantages-of-mysql (Accessed on 12/02/2017)
5. ByteScout., (2014). Available at: https://bytescout.com/blog/2014/09/ms-sql-server-history-and-advantages.html (Accessed on 12/02/2017)

Appendix S: User Testing Questions

Website Questions:

- Please can you login with the credentials provided to you
  Username: usertest
  Password: userpass1

- Please can you tell me the average size of a Golden Eagle
  _____
  __

- Please can you view your sightings and let me know how many sightings have been seen recently
  _____
  __

- Please can you view your account details and update the password to: **BirdBuddy**

- Please can you tell me the time and date of the latest sighting of a **Common Buzzard**
  _____
  __

On a scale of 1 – 10, how easy would you say it was to find the information above?

1 2 3 4 5 6 7 8 9 10

Is there anything you would change about the design of the overall website?

_____
_____
_____
_____
_____

What was your favourite part about the website?

_____
_____
_____

_____
_____

What was your least favourite part about the website?

_____
_____
_____
_____
_____

Android Application:

- Please can you login with the credentials provided to you
  Username: usertest
  Password: BirdBuddy

- Please can you log a sighting for a Black Headed Gull

- Please can you view your account settings and update your password to: **userpass1**

- Please can you view your sightings and tell me the rough location of the last Golden Eagle that you have seen

On a scale of 1 – 10, how easy would you say it was to find the information above?

1 2 3 4 5 6 7 8 9 10

Is there anything you would change about the design of the overall Application?

_____
_____
_____
_____
_____

What was your favourite part about the Application?

_____
_____
_____

_____
_____

What was your least favourite part about the Application?

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Space for any additional notes:

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Thank you for taking part in my user testing survey.

Appendix T: User Testing Consent Form

Please take some time to read through the information below before signing this documentation.

- This document has been created to ensure that you are aware of your rights before taking part in this test.
- You will shortly be asked to complete various questions based on your experience with the Android Application and Website created by Daniel Andrews for his Final Year Project at the University of Plymouth.
- During this time, you have the right to stop the task at any time and request that your information is not included in the research.
- You also have the right to have your information withdrawn after completion of this test. The cut off for your claim to be looked at is **05/05/2017**. If you wish to have your information withdrawn from the analysis, please contact: **************
- During the analysis of this information, you will not be identified. For this reason, please don't include any personal information about yourself in your results. You will only be referred to as a number. E.g. User 3.
- By signing this form, you consent to your voice being recorded for the entirety of the testing phase. This information will then be listened to by the developer at a later stage to ensure all verbal feedback is taken in to consideration.
- Throughout this process, the developer will be sitting with you always. Whilst this is an activity that should be undertaken by individuals, if you are struggling at any point, you will be able to ask the developer for some advice. The developer won't give you the answer, but they will guide you in the right direction.
- By signing this consent form you are confirming that you voluntarily are completing this research for analysis by the developer.

Users Signature: _____ Date: _____

Appendix U: Requirement Analysis

Android app

- **Add data when they see birds =** This is one of the most important key features of this project. The user will be able to select the bird that they have seen from a list of all available birds. They will then be able to press a button that stores the bird, longitude, latitude, time and date, and the username. This is to be used in the analysis of the data.
- **Create a list of birds they have seen =** The purpose of this is to keep track of the birds that you have seen. This is going to be a separate page where you can view a list of all the birds you have seen with the time that you saw them.
- **Create an account =** You must create an account to be able to add data points. Other than that, and viewing your seen birds, all functionality will be available without an account.
- **The bird was last seen here =** This is to give users an idea of where the bird you are looking for was seen last. You will only be able to see the longitude and latitude, you won't be able to see who entered the data point.
- **You're most likely to see one here =** This takes all data points in to consideration and tells you where you are most likely to see a selected bird. Again, this will only return the longitude and latitude, you won't be able to see who entered the data.
- **View all birds in the database =** Any user will be able to view a list of all the birds in the database. From here you will be able to select any bird and find more information about them. This can be useful when looking at the classification of the birds.
- **View information about individual birds =** You will be able to view key information about the bird selected, this will include: size, scientific name, an interesting fact and the vulnerability status.

This list of requirements is likely to change throughout the duration of this project. For this reason, this is named Requirement Analysis version 1.

Website

- **Create an account =** You must create an account if you want to see the list of birds that you have seen.
- **View list of seen birds =** You will be able to see the list of your seen birds, this is the same as the list on the Android application.
- **View all data points =** This will visualise the data to show you where the birds have been seen, this is also important for the following feature.
- **Viewing birds by time of year =** You will be able to view the data points based on the time of year. This will take in to consideration the migration of birds. For example, you will be able to view all data points recorded in Winter and Summer. This is subject to change however.
- **The bird was last seen here =** This is to give users an idea of where the bird you are looking for was seen last. You will only be able to see the longitude and latitude, you won't be able to see who entered the data point.
- **Search by location =** You will be able to see which birds are close to specific locations that you search. This will allow you to get an idea of what you are likely to see when you visit certain locations.
- **You're most likely to see one here =** This takes all data points in to consideration and tells you where you are most likely to see a selected bird. Again, this will only return the longitude and latitude, you won't be able to see who entered the data.
- **View all birds in the database =** Any user will be able to view a list of all the birds in the database. From here you will be able to select any bird and find more information about them. This can be useful when looking at the classification of the birds.
- **View information about individual birds =** You will be able to view key information about the bird selected, this will include: size, scientific name, an interesting fact and the vulnerability status.

This list of requirements is likely to change throughout the duration of this project. For this reason, this is named Requirement Analysis version 1.

Appendix V: Project Fair Poster

Appendix W: Analysis of Existing Systems

Android:

- ***Birds of Britain:***

  What it's about: This is an application that gives you the name of each bird in Britain, you can also see a picture of the bird, the length, colours and habitat.

  What is good: The app provides you with key information about each different bird. You can filter by habitat or size.

  What isn't: The app is very messy. It looks like there was no thought about the HCI when the application was developed. There are external links to Wikipedia, this could be seen as a good thing but at the same time seems lazy. When browsing, there is no way of sorting the results.

  How it relates to my app: The app has a list of the available birds in the UK.

- ***BirdID:***

  What it's about: An app that shows how to identify different types of birds. There are also quizzes to test you on your bird knowledge based on bird noises or pictures.

  What is good: Aesthetically it is a nice looking application. There is a lot of information and clear indications about the identification of different birds. There is a lot of information about the birds.

  What isn't: This is one of the nicest apps I have looked at in this process. There isn't anything about this app that I would change too much.

  How it relates to my app: The app is similar to my project in the sense that you can see a list of the birds and information about them. The app has an external link to a Birdguide distribution. This doesn't have too much information though.

- ***Bird Journal:***

  What it's about: This is the only app I have found that requires you to sign up before you can access the app.

  What is good: Simplistic app with a nice layout that allows you to create your entry points.

What isn't: You can't use the app unless you sign up for an account. It takes up to 10 minutes to setup the application upon first time using. There is no information about the birds other than the name. No images at all.

How it relates to my app: The app allows you to enter birds that you have seen. This allows you to select the county that you are in and the birds you have seen. This can then be sorted by date. This is similar to my application, however in my application the location is set automatically.

- ***Birder – Record birds you see:***

What it's about: This is an app that seems similar to my project in some ways. You are able to spot nearby birds based on distance and days since
it was spotted.

What is good: Clear User Interface. You can see a list of your sightings and birds nearby. Recent sighting map is really nice.

What isn't: You can only submit a certain amount of sightings without paying. There is no list of images for birds unless it has been seen recently. There isn't much information about the actual birds other than the name and a picture.

How it relates to my app: You can add data points and view nearby birds, however there is no way to see a list of all birds available and the information available is very limited.

- ***BirdsEye Bird Finding Guide:***

What it's about: This is an app that records your sightings. You need an account to see birds that are nearby.

What is good: You can view nearby birds and how likely you are to see them based on the time of year. The app also tells you if you have seen one of these birds.

What isn't: To actually log any seen birds you need to have a membership that cost roughly $4 a month. Whilst there is a lot of information available, there isn't a lot of information about the actual birds. The Nearby birds can range to anywhere within the county, this isn't really that nearby.

How it relates to my app: You can see nearby birds and log birds that you have seen (with a membership). In my application, the nearby ability will be a much closer radius though.

iOS:

- ***myRefuge:***

  What it's about: This is an app that gives you multiple maps of different areas within the united states. You can then view different national parks within each different state. Upon first look, this looked like an identification app. However, it appears to be an app that is used for navigating around different areas.

  What is good: There is a wide variety of different locations available to view in most states. You can view clear maps of wildlife reserves, this may aid in finding the different habitats of birds.

  What isn't: It isn't very clear how to work the app upon downloading. You have to download each map for each different state. It is only limited to the United States of America.

  How it relates to my app: The only way this app relates to my project is that you can see a map with data points. Whilst this looks like a good application and I can see the need for it. It doesn't help too much for bird identification or logging.

- ***Richiamo Uccelli Bird Watching:***

  What it's about: This app is a fairly basic application, you can view a list of birds and listen to the sounds that they make. There is also an option to listen to the noise on repeat.

  What is good: Each bird has a picture that is the same size and a clear recording of the noise it makes.

  What isn't: There is no way to order the birds other than A-Z. There is no identification system for the birds other than the sounds. There is no way to make note of the birds that you may have seen.

  How it relates to my project: The only way this application relates to my project is the ordering of the birds. Other than that, the apps are very different.

There are more bird watching apps on the Apple App Store. However, the only ones that are easy to find are paid apps. This shows a clear divide in the Apple App Store and the Google Play Store. On Android, a lot of the applications are available for free, this is something that should be taken in to consideration when marketing the app in the future.

All of these apps were downloaded and accessed on February 3rd 2017. Any changes made to the applications after this date were not taken in to consideration when reviewing these systems.

Appendix X: Android Features – Verification and Validation

Below I have included most of the functionality points within the android application. Beneath each of the features, you are able to see the reasoning behind the features and how they help the overall application to fulfil its purpose.

- Login

Verification: Being able to log in to the system is crucial to the application that I have created. Whilst you don't have to login, by logging in, you are able to log your own sightings, view your own sightings, and upload community images. To login, you must provide your username and password to the application.

Validation: Logging in isn't necessary each time that you enter the application. When you have logged in, you are logged in until you press the logout button. This has been done to allow for an easier user experience. This is especially essential for when you are wanting to log a sighting.

- Register

Verification: Registration is just as important. Without being able to register for an account, you won't be able to login to the system. To register your account, you need to provide an email address, a username and a password.

Validation: You will only need to register for an account once. The information required doesn't ask the user for any personal information other than their email address. This has been done to insure the user feels safe when using the application.

- Continue as a guest

Verification: The ability to continue as a guest in the system was something that I had always intended on doing. By continuing as a guest, you are able to access all of the functionality that you would as a user, except you can't log a sighting or view your own sightings.

Validation: By having the option to continue as a guest, the user is able to get a feel for the application and see exactly what it is like without the need to sign up. This may even encourage the user to sign up at a later stage.

- Log sightings

Verification: Logging a sighting is one of the key points of this application. The aim is to allow the user to select a bird from a ListView that is filled from a PHP script server side. Then, providing they are logged in to the system and have their location settings enabled, they are able to log a sighting for this bird. The process is quick and simple. Upon logging a sighting, the screen refreshes.

Validation: Simplicity has been essential to me whilst making this application. For this reason, the user simply needs to select the bird and press log. Providing they are signed in and their location settings are enabled, this will log the sighting instantly. When selecting the bird from the list, they are shown an image of the bird. This will be their last chance to ensure that they are sure that this is what they have seen.

- View sightings as list

Verification: Users are able to view their sightings in a list view. This gives them the opportunity to look back at where they have seen specific birds. This also gives them the chance to have a look at where they may see the birds again. You can then click on each of the entries in the list to view the information on a map.

Validation: The list of sightings reloads as soon as a new sighting has been logged. The ability to click on each sighting aids in the visualisation process of seeing where you have been, and what you have seen. When you load the maps instance, you are able to go to google maps from within the application to guide you to the exact location of the sighting.

- View sightings on map

Verification: The user can also view a google maps instance that contains a pin for each of their sightings. The user is presented with a map of their sightings with pins that they can click on to give them more information about the sighting.

Validation: Again, this has been done in a simplistic way to give the users the most possible information in the clearest way possible. This has been included as it is a way for the user to visualise where they have been and be able to see hot spots for where they have seen a lot of birds.

- View birds within a 5-mile radius of your current location (that have been logged in the last week)

Verification: Nearby birds allows the user to view all of the birds that have been sighted in the last week within a 5 mile radius. Being able to see the sightings that have been seen around you has been one of the core functionality points to this application from the beginning. Having this in place allows the user to understand what they are likely to see, and also gives them the opportunity to move around more in search of new birds.

Validation: To ensure the nearby birds are as accurate and up to date as possible, you have an update location on the page, which can be used to update your location. This allows you to see if you are getting closer to the birds, or whether you need to move in the other direction. Nearby birds only show you sightings that have been logged in the last week. This is to ensure that the information available to you is as accurate as possible.

Initially, you would only be able to see one of each species of bird, this was changed to take flocks of birds in to consideration.

- View a library of bird

Verification: The library of birds was something that was very important for me from the very beginning. The user can view a list of all of the birds in the database. They are then able to click on any of the birds in the list to find out more information about the bird, including a fact about the bird, the conservation status of the bird and the size of the bird.

Validation: You are able to see a list of birds and search through this list to find the right bird that you are looking for. This can be crucial for identification of certain species of birds. This is especially useful when you are looking at very similar birds.

- View in-depth information about each bird

Verification: The ability to view each bird in-depth is crucial to the identification of birds within my application. You are able to find out more information about the birds this way. There are also three buttons within this section for each of the birds. This gives you the opportunity to see the sightings that have been logged for each of the birds.

Validation: You can find all of this information by clicking on one of the rows within the list view. This doesn't clutter the design of the list with too much information. From here you can also learn about all of the sightings for the selected bird.

- View the sighting details for the last time the bird was seen

Verification: This feature was one of the first ideas that I had whilst developing the android application. Being able to see where the bird was last seen isn't a crucial functionality point, but is nice for the user to see. Especially for birds that are rare.

Validation: This feature is one of the only features that can't be found within the navigation drawer. This information is found within the information for each bird. This allows for a much simpler user experience. If this was a feature in the navigation drawer, you would have to select the bird that you want to view first.

There is error handling in place in case there haven't been any sightings for the selected bird. Whilst

- View a list of up to 7 of the places that you are most likely to see the bird (based on your location)

Verification: Most likely to see is a feature similar to the last seen, however you are able to see up to 7 of the closest sightings to you. This allows you to select the one that is either the closest to you, or the one that was seen last, and go in that general direction. Whilst this won't necessarily mean you will see the bird, it gives you a much better chance than if you were to search by yourself.

Validation: This is another feature that you can find when looking at the information of the bird. Initially, you would only see the sighting that was logged closest to your location. However I changed this to allow you to have a wider range of sightings available.

I imagined the scenario where one sighting was logged 3.0 miles away 6 months ago, and another was logged 3.01 miles away yesterday. This would show the user that they are most likely to see the bird 3.0 miles away, however realistically this isn't the case.

- View a map of all of the sightings for each bird

Verification: This allows the user to see a heat map of each sighting logged for each specific bird. This can be a clear indicator of where you are likely to see a specific bird. It is important to take the time of year in to consideration when looking at this though.

Validation: This is the third feature that can be found within the information about specific birds. Again, this is to prevent the Navigation drawer becoming over-crowded.

- View the sightings by different time of year (Winter, Spring, Summer, Autumn)

Verification: It is a well-known fact that certain birds migrate throughout the year. The ability to see where the birds have been sighted at different times of the year will help the user to understand where and when they may see specific birds.

Validation: This feature is crucial for new users that may not know the flight patterns of certain birds. This will prevent disappointment of the users when they think that they may see a certain bird in one location because they saw one there at a different time of year.

- Search a map and see all of the birds that have been logged in the surrounding area (shows all sightings within the last two weeks)

Verification: This feature allows the user to search for a general location. They are then able to view all of the sightings in this surrounding area in the last two weeks. This will then show the user an array of markers. If you click on one of the markers, you are able to see the name of the bird and the creation time.

Validation: This feature can be useful if you are going on a trip to a new place and you want to know what you are expecting to see. By showing the sightings logged in the last two weeks, you will only be seeing relevant and up to date information.

- View birds by habitat.

Verification: The habitat feature is used for users to see what birds they are likely to see in each habitat. This is one of the features that is aimed towards the identification of birds rather than the distribution of birds.

Validation: This feature allows the user to select an option from the drop down box provided. This contains all of the different habitats available within the application. When selected, the user will see each bird that lives in this habitat. This will help new users to understand what they may see in these areas.

- View a list of birds based on size. (Small = less than 30cm, in-between is 31 to 59cm, large = over 60 cm)

Verification: The “What did I see?” feature, was developed later on in the development process. The aim of this feature, was to break down the different birds that you can find within the system to three separate groups. The user is given a prompt that informs them what the different buttons are for on the screen.

Validation: This feature helps the user to identify what bird they have seen by size. This is essentially useful for users that are new to the community. The user is then able to click on the bird and see the same information that they would if they were searching within the library.

- About us page

Verification: The about us page gives the user the ability to see how and why the application was developed. The about us gives a brief description about the aims for the project, including an estimated eventual release date of the project.

Validation: The about us page is located in the settings menu. It is integral for the application as it gives the user a chance to see why the project has been developed and also allows the users to see which libraries were used throughout development.

- Logout

Verification: Logging out is a feature that comes with logging in. Without this feature, the user would be logged in forever.

Validation: Logging out is necessary only when you have logged in to the system. This allows the user to switch accounts, or sign in to their account on a temporary device. To logout, you must open the settings menu in the top right corner, then press logout. This takes you to the main screen.

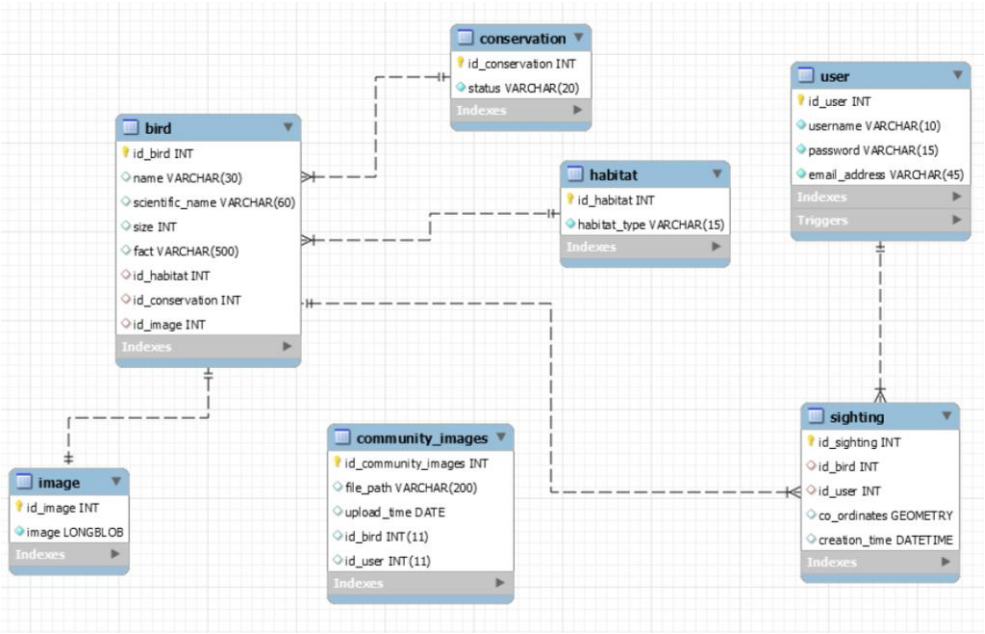
Appendix Y: Resources Used

Resource	**Information**	**Resource Type**
Daniel Andrews	Daniel.andrews@students.plymouth.ac.uk	Developer
Nigel Barlow	Nigel.Barlow@plymouth.ac.uk	Project Supervisor
AWS	https://aws.amazon.com/	Hosting
EcoWebHosting	ecowebhosting.co.uk	Hosting
Android Studio	https://developer.android.com/studio/index.html	Development Software
PHP Storm	https://www.jetbrains.com/phpstorm/	Development Software
phpMyAdmin	https://www.phpmyadmin.net/	Development Software
MySQLWorkbench	https://www.mysql.com/products/workbench/	Development Software
Android Developer Website	https://developer.android.com/index.html	Supporting Documentation
Google Maps API (Android)	https://developers.google.com/maps/android	API
Google Maps API (Web)	https://developers.google.com/maps/	API
Microsoft Word 2016	https://www.office.com/	Software for creating supporting documentation
Microsoft Excel 2016	https://www.office.com/	Software for creating supporting documentation
Microsoft Visio 2016	https://www.office.com/	Software for creating supporting documentation
Bootstrap	https://v4-alpha.getbootstrap.com/	Supporting Documentation
Samsung Galaxy S7 edge	http://www.samsung.com/uk/smartphones/galaxy-s7/overview/	Testing Device (Android 7.0)

Samsung Galaxy S6	http://www.samsung.com/uk/smartphones/galaxy-s6-g920f/SM-G920FZKABTU/	Testing Device (Android 6.0.1)
Samsung Galaxy S4	http://www.samsung.com/uk/smartphones/galaxy-s4-i9505/GT-I9505ZKABTU/	Testing Device (Android 5.0)
Google Chrome	https://www.google.com/chrome/	Testing web functionality
Firefox	https://www.mozilla.org/en-GB/firefox/new/	Testing web functionality
Fire FTP	https://addons.mozilla.org/en-Gb/firefox/addon/fireftp/	Supporting Documentation
Development PC (Windows 10)	Custom built PC.	Software development
Development Surface Pro 4 (Windows 10)	https://www.microsoft.com/en-gb/store/d/product/8VV4N8VBQG7C/53P9?icid=Cat-Surface-ContentPlacement_20_2-SurfacePro4-042517-en_GB	Software development
Stack Overflow	https://stackoverflow.com/	Supporting Documentation
Material Design	https://material.io/guidelines/material-design/introduction.html	Supporting Documentation

Appendix Z: Database ERD

Database ERD



Above you will see my Entity Relationship Diagram for my database. As it stands there are currently seven different tables, that all relate to each other in some way. This may be subject to change after the project has finished. The only table that doesn't appear to be connected is the community_images table. This does have relationships with the user table and the bird table, but they aren't physical relationships.

The connections are as follows.

- There is a one to one connection on the image and bird table. This is because a bird can only have one image, and the image can only belong to one bird.
- There is a one to many relationship between the habitat and the bird. The bird can only have one habitat, but there are many different habitats available
- There is a one to many relationship between the conservation and a bird. The bird can only have one conservation status, but there can be many different conservation statuses.
- There is a one to many relationship between the user and sighting tables. The user can have many sightings, but the sighting can only belong to one user.
- There is a one to many relationship between the bird and the sighting. A bird can be in many sightings, but the sighting can only be associated to a single bird.
- The community_images table has a relationship with the id_user field. The id_user is added when the image is uploaded. The same is applied to the id_bird. Both of these relationships are 1 to many. There can only be one id_user for each community image but an id_user can have multiple community images. Initially, there would be a relationship with the id_bird column. This was changed very late in the project to just "name". This isn't reflected in the ERD. This was changed to allow users to upload images of all birds / wildlife instead of limiting to just the current birds.

Appendix AA: Bird Information and Sources

Information for the first 31 birds have been accessed on the 13th of September

The information for birds 32 – 51 was accessed on April 9th.

1. Little Grebe

Image: https://en.wikipedia.org/wiki/Little_grebe#/media/File:Little_grebe_Zwergtaucher.jpg

Information: http://www.arkive.org/little-grebe/tachybaptus-ruficollis/

https://en.wikipedia.org/wiki/Little_grebe

2. Great Crested Grebe

Image: http://www.bbc.co.uk/staticarchive/7c52975c7eef7216c7c141e218808fee7bb74195.jpg

Information: https://en.wikipedia.org/wiki/Great_crested_grebe

3. Great Cormorant

Image: http://orientalbirdimages.org/images/data/great_cormorant1.1.jpg

Information: https://en.wikipedia.org/wiki/Great_cormorant

4. Little Egret

Image: http://www.lympstone.org/wp-content/uploads/2011/03/Little-Egret-2.jpg

Information: https://en.wikipedia.org/wiki/Little_egret

5. Mute Swan

Image: https://eastdalesringinggroup.files.wordpress.com/2016/05/swan-mute.jpg

Information: https://en.wikipedia.org/wiki/Mute_swan

6. Bewick Swan

Image: http://s0.geograph.org.uk/geophotos/03/20/43/3204391_55ae9275.jpg

Information: https://en.wikipedia.org/wiki/Tundra_swan

7. Canada Goose

Image: https://www.allaboutbirds.org/guide/PHOTO/LARGE/canada_goose_1.jpg

Information: https://en.wikipedia.org/wiki/Canada_goose

8. Mallard

Image: https://s-media-cache-ak0.pinimg.com/originals/3e/9d/eb/3e9deba06585617618cea56d26cc9db7.jpg

Information: http://www.softschools.com/facts/animals/mallard_duck_facts/587/

9. Moor Hen

Image: https://s-media-cache-ak0.pinimg.com/originals/85/1d/0d/851d0d4640b25cc4f70c0bf6d1081bb6.jpg

Information: http://www.garden-birds.co.uk/birds/moorhen.htm

https://www.rspb.org.uk/discoverandenjoynature/discoverandlearn/birdguide/name/m/moorhen/

http://www.arkive.org/common-moorhen/gallinula-chloropus/

10. Honey Buzzard

Image: http://www.birds.iitk.ac.in/sites/default/files/oriental_honey-buzzard_01.jpg

Information: https://en.wikipedia.org/wiki/European_honey_buzzard

11. Red Kite

Image: http://www.rspb.org.uk/community/cfs-file.ashx/__key/CommunityServer.Discussions.Components.Files/901/3252.IMG_5F00_7581.jpg

Information: http://www.redkites.net/section72403_17698.html

http://www.forestry.gov.uk/forestry/redkite

12. Golden Eagle

Image: http://wildlifearticles.co.uk/wp-content/uploads/2015/12/Golden-Eagle_4_medium.jpg

Information: https://www.allaboutbirds.org/guide/Golden_Eagle/lifehistory

https://en.wikipedia.org/wiki/Golden_eagle

13. Harris Hawk

Image: http://animalia-life.club/data_images/harris-hawk/harris-hawk2.jpg

Information: https://en.wikipedia.org/wiki/Harris%27s_hawk - Distribution_and_habitat

https://www.allaboutbirds.org/guide/Harriss_Hawk/lifehistory

14. Kestrel

Image: http://1.bp.blogspot.com/_oAhlCXJR_cQ/RfzWL--bypI/AAAAAAAAAo4/5ACAbvxaknE/s1600/SE-Female%2BKestrel,%2BAlconbury%2B3135.jpg

Information: http://www.garden-birds.co.uk/birds/kestrel.htm

http://www.rspb.org.uk/community/wildlife/f/13609/t/9031.aspx

15. Common Buzzard

Image: https://a-z-animals.com/media/animals/images/original/common_buzzard1.jpg

Information:

16. Peregrine Falcon

Image: http://www.sdfalconry.com/wp-content/uploads/2013/06/IMGP6404edit.jpg

Information: https://en.wikipedia.org/wiki/Peregrine_falcon

17. Common Pheasant

Image: https://forum.americanexpedition.us/images/common-pheasant/common-pheasant-on-green-grass.jpg

Information: https://en.wikipedia.org/wiki/Common_pheasant

18. Coot

Image: http://www.celestialgrace.org/musicplayer/images/Birds/bird_coot.jpg

Information: https://en.wikipedia.org/wiki/Coot

19. Oystercatcher

Image: http://www.birdforum.net/opus/images/thumb/d/d1/Eurasian_Oystercatcher.jpg/550px-Eurasian_Oystercatcher.jpg

Information: https://en.wikipedia.org/wiki/Oystercatcher

20. Sanderling

Image: https://upload.wikimedia.org/wikipedia/commons/7/73/Calidris_alba_-_Laem_Phak_Bia.jpg

Information: https://en.wikipedia.org/wiki/Sanderling

21. Curlew

Image: https://i.ytimg.com/vi/1Jch6qpD4J8/hqdefault.jpg

Information: https://en.wikipedia.org/wiki/Curlew

22. Black Headed Gull

Image: https://hullvalley.files.wordpress.com/2013/03/danish-ringed-black-headed-gull-hornsea-mere-100313a-leo.jpg

Information: https://en.wikipedia.org/wiki/Black-headed_gull

23. Common Gull

Image: http://www.naturephoto-cz.com/fullsize/birds/common-gull-42536.jpg

Information: https://en.wikipedia.org/wiki/Common_gull

24. Carrion Crow

Image: http://www.reddishvale.moonfruit.com/communities/2/004/005/690/022/images/4517854764.jpg

Information: https://en.wikipedia.org/wiki/Carrion_crow

25. Yellow Legged Gull

Image: http://sognet.org.uk/Images/082908%20-%20adult%20Yellow-legged%20Gull%20WEB%20ID%20135.jpg

Information: https://en.wikipedia.org/wiki/Yellow-legged_gull

26. Atlantic Puffin

Image: http://animalstime.com/wp-content/uploads/2016/01/atlantic-puffin.jpg

Information: https://en.wikipedia.org/wiki/Atlantic_puffin

27. Wood Pidgeon

Image: http://www.animalphotos.me/bird/bird-wood_files/wood_pigeon5.jpg

Information: https://en.wikipedia.org/wiki/Common_wood_pigeon

28. Stock Dove

Image: http://www.animalphotos.me/bird/bird-stock_files/stock_dove3.jpg

Information: https://en.wikipedia.org/wiki/Stock_dove

29. Barn Owl

Image: http://www.cqsisu.com/WDF-1066891.html

Information: https://en.wikipedia.org/wiki/Barn_owl

30. Swift

Image: https://upload.wikimedia.org/wikipedia/commons/thumb/b/be/Apus_apus_-Barcelona%2C_Spain-8_%281%29.jpg/220px-Apus_apus_-Barcelona%2C_Spain-8_%281%29.jpg

Information: https://en.wikipedia.org/wiki/Swift

31. Barn Swallow

Image: http://www.moorsforthefuture.org.uk/sites/default/files/csp/swallow%20300x200.jpg

Information: https://en.wikipedia.org/wiki/Barn_swallow

32. Kingfisher

http://animal-dream.com/data_images/kingfisher/kingfisher5.jpg

Info found at: https://en.wikipedia.org/wiki/Common_kingfisher

33. Green Woodpecker

http://farm4.static.flickr.com/3119/3160201774_e87c2e915d.jpg

Info found at: https://en.wikipedia.org/wiki/European_green_woodpecker

34. Sparrow Hawk

http://www.mbaker.co.uk/images/Local%20Birds/Sparrowhawk%20-3.jpg

Info found at: https://en.wikipedia.org/wiki/Eurasian_sparrowhawk

35. Skylark

http://www.birdforum.net/opus/images/thumb/e/ef/Eurasian_Skylark2.jpg/550px-Eurasian_Skylark2.jpg

Info found at: https://en.wikipedia.org/wiki/Eurasian_skylark

36. Sand Martin

https://upload.wikimedia.org/wikipedia/commons/0/04/Riparia_riparia_-Markinch%2C_Fife%2C_Scotland_-flying-8-4c.jpg

Info found at: https://en.wikipedia.org/wiki/Sand_martin

37. House Martin

http://2.bp.blogspot.com/-5Lvwu-o_vbs/VGrVxFTTYxI/AAAAAAAACNU/a1GzboiW3hI/s1600/house_martin.jpg

Info found at: https://en.wikipedia.org/wiki/Common_house_martin

38. Redstart

https://upload.wikimedia.org/wikipedia/commons/c/c8/Daurian_Redstart_9873.jpg

Info found at: https://en.wikipedia.org/wiki/Common_redstart

39. Wren

http://aperture.adfero.co.uk/Image/Original/14114602

Info found at: https://en.wikipedia.org/wiki/Eurasian_wren

40. Chaffinch

http://www.birdforum.net/opus/images/thumb/e/e1/Chaffinch.jpg/550px-Chaffinch.jpg

Info found at: https://en.wikipedia.org/wiki/Common_chaffinch

41. Robin

https://aipetcher.files.wordpress.com/2012/04/robin_0346s.jpg

Info found at: https://en.wikipedia.org/wiki/European_robin

42. Black Redstart

http://farm9.static.flickr.com/8294/7675048838_b716b62aa4.jpg

Info found at: https://en.wikipedia.org/wiki/Black_redstart

43. Black Swan

Already have

Info found at: https://en.wikipedia.org/wiki/Black_swan

44. Black Bird

http://www.mbaker.co.uk/images/Local%20Birds/Blackbird-6.jpg

Info found at: https://en.wikipedia.org/wiki/Common_blackbird

45. Long Tailed Tit

http://www.sulgrave.org/BIRDS/Long%20tailed%20tit%2004w.jpg

Info found at: https://en.wikipedia.org/wiki/Long-tailed_tit

46. Coal Tit

http://www.feedyourbirds.co.uk/media/iStock_pics/Coal_Tit_2x.jpg

Info found at: https://en.wikipedia.org/wiki/Coal_tit

47. Blue Tit

http://2.bp.blogspot.com/-4zuRgFxtmSs/UNyqThoZoGI/AAAAAAAABEw/Y_3FekASZss/s1600/Blue-Tit29.jpg

Info found at: https://en.wikipedia.org/wiki/Eurasian_blue_tit

48. Jay

https://farm4.staticflickr.com/3683/13565072893_5e61266771.jpg

Info found at: https://en.wikipedia.org/wiki/Eurasian_jay

49. Magpie

http://images.fineartamerica.com/images-medium-large-5/a-magpie-tommy-hammarsten.jpg

Info found at: https://en.wikipedia.org/wiki/Eurasian_magpie

50. Jackdaw

http://i1.treknature.com/photos/3914/jackdaw.jpg

Info found at: https://en.wikipedia.org/wiki/Western_jackdaw

51. Bullfinch

http://songbirds-slaughter.org.uk/wp-content/themes/ThrillingTheme/thumb.php?src=http://songbirds-slaughter.org.uk/wp-content/uploads/2011/11/Bullfinch.jpg&h=400&w=540&zc=3&q=95

Info found at:

https://en.wikipedia.org/wiki/Eurasian_bullfinch