Requirements Specification Document, v2.0

Team Bird's iView

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Overview: This document will serve as a contract between Bird's iView and our client, David Plemmons. The following pages describe the requirements that Bird's iView will implement during the developmental phase.

Accepted as baseline requirements for the project:

For the client: _____ date:_____

For the team: _____ date:_____

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1. Introduction

More than 50 million people spend more than $40 billion every year on bird-related equipment and travel. Birding activities can bring people not only spiritual pleasure, but bring huge economic effects. “Birding in the United States: A Demographic and Economic Analysis” (U.S. Fish and Wildlife Service), an addendum to the 2011 National Survey, shows that bird watchers spend nearly $41 billion annually on trips and equipment. Local community economies benefit from the $14.9 billion that bird watchers spend on food, lodging and transportation. In 2011, 666,000 jobs were created as a result of bird watching expenditures. In September 2017, a presentation at the American Birding Expo found that, among other events, the Space Coast Birding Festival generated nearly $1.3 million over 5 days.

According to the above data, we can find that the bird-watching industry has a huge market. Additionally, the bird-watching industry can bring great spiritual enjoyment to people by connecting with nature. There are about 10,000 species of birds living in countless habitats on seven continents, with different sizes, different color patterns of feathers, and even different songs and actions. Birding is also good for your health as it provides great pleasure to observe a wide variety of birds. To find rare species, you may take a hike outdoors.

More importantly, birding also allows you to make friends. You may meet people who have the same hobby of watching a particular kind of bird and become friends with them. Nowadays, with the internet you can make friends with people who live on the other side of the world.

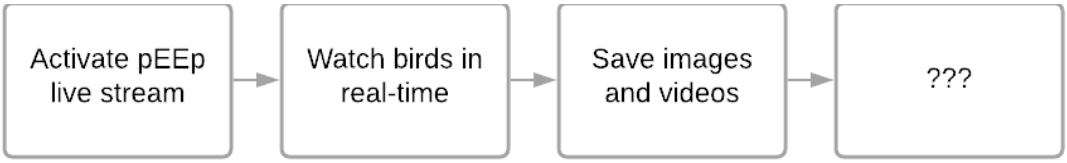
Our client, David Plemmons, is an avid bird watcher and enthusiast. He has been working hard over the last three years to bring his vision to fruition. His product, the pEEp Smart Feeder, aims to get people more involved with the birds around them by providing an educational platform and vibrant community for people to connect and grow with other like-minded individuals.

The pEEp Smart Feeder allows pEEp users to watch birds at home without having to go outside. Through the camera, people can watch their birds eating, as shown in the picture below.

A bird feeder like this costs around $300, but we still think it needs improvement. For example, there is no way for users to know what kind of birds they are taking photos of, and there is no good sharing platform. We'll look at this in more detail in the problem state part that follows.

2. Problem Statement

The current state of pEEp consists of customers that are able to purchase the pEEp product which includes the bird feeder, along with an integrated camera, and an android TV box. The integrated camera and the TV box allows for David's customers to watch their personal live stream whether that's on the TV. Additionally, bird-lovers are able to save their bird images and videos to their computer. In regards to the current workflow of pEEp, the diagram below illustrates the user experience that pEEp offers and the idea that more implementations are necessary in order to satisfy David's complete vision.



This leads us to discuss the current limitations of the pEEp product which are listed below.

Sharing System for Images/ Videos

The current workflow of pEEp allows for users to save their bird images and videos, but what happens after that?

- There is no organizational system for users to save images.
- Images/ videos could get lost due to lack of organization.
- No easy way to efficiently share images.
- No easy way for users to connect with the community by sharing images.

Classification of Bird Species

Having a system that allows for the classification of bird species would aid in the education for pEEp bird watchers.

- No easy way for users to find out and verify what bird visited their bird feeder.
- Not easy for users to connect with bird experts to review user self-classifications.
- Tedious and time consuming for users to identify bird species on their own.

Although the pEEp product has come a long way, there are still many limitations that need to be fixed. In the following section, we will discuss our solution as to how we will be addressing each drawback.

3. Solution Vision

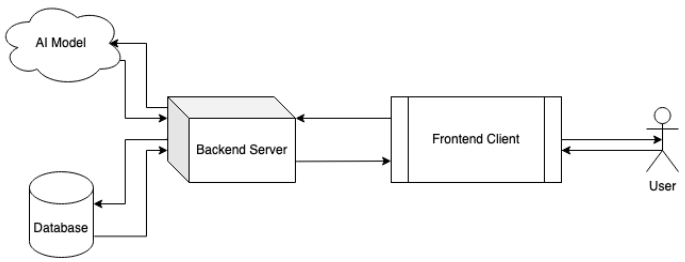
The proposed solution to the problems enumerated above is a web application that integrates with the pEEp Smart Feeder, which will serve as a platform where users can interact with the images and videos they have captured via the feeder's integrated camera. This interaction will be centered around the two most important problems from the previous section, namely 1) the inability for people to seamlessly share their findings with others and 2) the lack of educational tools provided to users of the pEEp Smart Feeder. The envisioned solution to these problems will revolve around a method of sharing that is easy, efficient, and flexible, as well as an educational module where users will have access to tools to learn more about the birds in the images and/or videos they have saved.

Specifically, the pEEp website will provide:

- a community forum and social media sharing options for users to interact with others on and off of the pEEp website.
- an educational module which provides tools that users can apply to learn more about the images and videos they have taken.

The community forum will allow registered users to start new discussions and comment on other's discussions, allowing users of the pEEp Smart Feeder to ask questions, share their expertise, and show off the stunning images captured by pEEp's integrated camera. These discussions will be stored in our database in order to remain viewable by everyone who visits the forum. In addition to the community forum, the pEEp site will also provide options for sharing to social media platforms (e.g., Facebook) in order to encourage others to use pEEP.

The educational module, which will hereafter be referred to as "pEEp Learn", will provide basic tools for predicting the species of a bird within an image or video. This module is where the main computational work for the website will occur, as it will 1) it will receive images or videos from users, 2) predict the species of the bird within the image or video using a robust AI module, and 3) relay the predicted information back to the user. The novelty of this system, however, comes from the fact that users will be integral to expanding future versions of pEEp Learn by submitting their personally classified images to our data set.



4. Project Requirements

4.1. Intro

In order to fulfill our solution vision, a series of requirements are necessary for the development process. The requirements listed below provide a detailed guideline for implementation of the overall design of our product, and work together to completely describe the system that we will build for our client.

4.2. Domain-level Requirements

Domain-level Requirements (DRs) represent the top-level requirements for a system as seen by the user. For the pEEp website, these top-level requirements will reflect the general functions that our website must deliver on, and will serve as a basis for the more technical requirements described in the following subsections. Enumerated below is a list of DRs that describe the key goals we plan to deliver to fulfill David's vision.

- **DR1 -** Minimal learning curve
- **DR2 -** Personal accounts
- **DR3 -** Customizable account settings
- **DR4 -** Efficient website uploads
- **DR5 -** Educational tools
- **DR6 -** Platform to connect
- **DR7 -** Mechanism to contribute

DR1: Minimal learning curve

A top concern for this project is making a website that people want to use. Because of this, we are centering our design around a User Interface (hereafter referred to as UI) that is capable of being learned by people of all ages, with all levels of technical experience, in a painless and efficient manner. Because many startups fail to maintain user engagement, we will focus on minimizing the time users must spend on any initial setup and configuration, as well as the time it actually takes to become accustomed to the layout of the pEEp website.

DR2: Personal accounts

Because we want the pEEp website to be convenient for people to use, there will be an option for users to create their own profile. In doing so, they will be able to provide some biographical information about themselves for others to see, have the ability to save images to their personal gallery, and be able to both create new discussion threads as well as contribute to other's discussion threads.

DR3: Customized account settings

Given that users will have their own account, it is important to consider account settings. There will be a privacy setting that will allow users to make their profile public or private. By making their profile publicly available, anyone will have access to view the photos on their account. To support a robust account system, we will also design a backup authentication (likely via email) that will allow users to reset their passwords should they forget.

DR4: Efficient website uploads

The core functionality driving this project is the ability for users to capture their own images and apply our educational toolkit to learn more about the birds in their yard. To do this, we must provide an efficient method for users to transport their images from their personal computer onto the website, where they can learn about and share their images.

DR5: Educational tools

After images have been successfully uploaded to the pEEp website, the user will have the option to use tools provided by pEEp Learn to educate themselves about the birds they've photographed. The first tool that will be developed is the bird identification tool, which will tell the users the species of a bird in an image. After this first tool is developed, additional tools will be created which will aim to identify unique birds of the same species.

DR6: Platform to connect

Another central goal for the pEEp website is to provide a community where people of similar interests can interact with each other. To do this, we need to provide a platform for users to interact with others. This platform will include a community forum where users can share their experiences, knowledge, and questions. In doing so, we will cultivate a community where people using the pEEp Smart Feeder can learn and grow from each other.

DR7: Mechanism to contribute

The pEEp educational toolkit will begin with a bird classifier that is able to distinguish three (3) different species of birds. In order to expand this classifier to handle more species, the pEEp data set must expand with new, verified classifications of different species of birds. To do this, we will encourage users to classify their own images if the species within the image is not yet supported by our educational toolkit, and provide a mechanism for experts to review their classifications before they are added to the pEEp data set.

4.3. Functional Requirements

Functional requirements (FRs) serve to specifically describe the core functionalities required for a project to deliver the top-level DRs. Given this relationship, we will use the DRs described in the previous section as a starting point from which we will decompose top-level requirements into progressively more specific system requirements. Functional requirements, specifically, tell us **what** the system will need to deliver on.

- **DR1** - Minimal learning curve
  - User Interface Design
    - **FR1 -** The design of our user interface should be clean, simple, and easy to navigate. It should also be intuitive for users to learn to use our web application.
- **DR2** - Personal accounts
  - User profiles stored on a database
    - **FR2 -** Secure connections for transporting data to and from the database, thus preventing attackers from intercepting traveling data.
    - **FR3 -** Encryption for stored data, so all data is secure within the database.
- **DR3** - Customizable account settings
  - Profile page
    - **FR4 -** Users will have access to a simple profile customization page, where they will be able to toggle all settings offered for user accounts.
- **DR4** - Efficient website uploads
  - User images stored on a database
    - **FR5 -** The database must provide the user with a storage space where they can upload the images saved from the pEEp feeder.
- **DR5** - Educational tools
  - Educational toolkit powered by an AI module
    - **FR6 -** The AI module must be integrated with the primary backend server that processes user requests.
    - **FR7 -** The AI module must utilize a trained Convolutional Neural Network (CNN) capable of predicting a minimum of three different species of birds within images.

        - **FR8 -** The AI module must also record the confidence level of each classification, and include that in the result of the prediction.
    - User access to AI module
        - **FR9 -** Users will be able to apply all educational tools from a dedicated page on the site, where the options for species prediction will be obvious.
        - **FR10 -** Users will have access to instructions regarding proper use of the educational tools, as well as tips for interpreting the results.
- **DR6** - Platform to connect
    - User access to pEEp community forum
        - **FR11 -** Users will be able to post photos publicly to the community forum if desired.
        - **FR12 -** Users will be able to comment and favourite other users' posts.
    - Non-member access to community forum
        - **FR13 -** Users that have not yet created an account will still have some access to the community forum
    - Expert access to pEEp community forum
        - **FR14 -** Experts will have admin access to the pEEp community forum to share their expertise on posted questions.
- **DR7** - Mechanism to contribute
    - Expanding pEEp Learn
        - **FR15 -** Users will have the option to classify their own images with the species they think the bird belongs to.
        - **FR16 -** Users will be able to submit a request to have their personally classified images reviewed by an expert.
        - **FR17 -** Bird experts will be granted access to an additional page on the website, where they will be presented with an interface for reviewing user classifications.
        - **FR18 -** After verification, bird experts will be able to send out the new images to the pEEp data set.
        - **FR19 -** Once a certain threshold of images is obtained for a specific species, the AI module will train a new CNN, including this new species as an additional class.

FR1 - User Interface Design

The design of our user interface is incredibly important to us. As the majority of our users will be of an older population, we can make the assumption that the user will need either an intuitive interface or a help page. Our web application will include both. There will be a help tab that will assist users in navigating the pEEp site. This will demonstrate how to upload images to send to the AI model, share images, and view their own personal library. The design of the UI will also be very clean and simple. The buttons will be straightforward, for example, the “SIGN UP” button will bring you to the sign up page, “EXPLORE” will bring you to the community forum, and so forth. Overall, the application will be uncluttered, and easy to navigate.

FR2 - Secure connections

Connection security is imperative to prevent any data leakage, whether it be user submitted or added by the developers. Integrating a pre-constructed firewall will allow for data to travel to and from the database without risk of data loss or false authentication.

FR3 - Encrypted data

Data within the database will be stored through encryption. Thus, all information will be unreadable to any outside sources without proper authentication. It is important that the encryption is not easily broken to provide the best security for user submitted data and personal information, so we will use trusted encryption schemes.

FR4 - Profile customization

It is important for users to have the ability to manage their personal account settings. Some users may want their profile to be completely private whereas other users may want to share their profile with the entire community. The profile customization page will also allow users to update their personal information such as their name, email address, and password. We will also provide a backup authentication system for users in case they have forgotten their password.

FR5 - Storage space for user's images

The images will be stored alongside user data. It is important to manage The image space in the best way possible to maximize our storage. Within the databases the images will have a unique identifier to properly link them to their respective user.

FR6 - AI Module integrated into backend

The backend server running the pEEp website will be the sole entity in the system that is capable of interacting with the AI module. That is to say, image classification requests will be made from a user on the client side, communicated to the backend, and then the backend will utilize the tools provided by the AI module to perform the job required. Through this design, we alleviate the computational cost of performing CNN inferences from the user by doing the computation on the server, and simply send the result back to the user.

FR7 - Trained CNN that predicts bird species

The crux of the pEEp website will be the ability for our educational toolkit to perform accurate species classifications for user's personal images. To do this, we will train a CNN on a dataset of labeled bird images. In the beginning, we will include only 3 species, but the capability of this model will be expanded by the influx of new labeled data due to user classifications.

FR8 - Recording the confidence of a prediction

Given the nature of the mathematics behind learning applications, we will never truly be able to achieve a level of 100% accuracy in model predictions. Additionally, some images of birds may simply not be representative of the species. For example, half of a bird's body may be out of frame. In this scenario, it is likely that our model will have a lower confidence rating on the prediction it produces. This confidence rating will serve to aid the user in interpreting the prediction(s) made by the model.

FR9 - A dedicated page for accessing the pEEp Learn

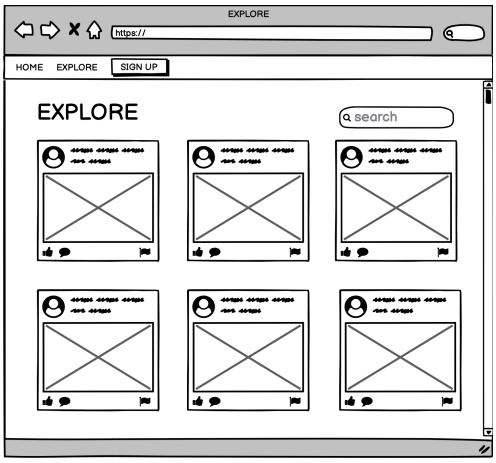
After users have uploaded their personal images to the site, they will need a dedicated page where they can apply our educational tools. To provide this, we will have a page in the pEEp site where users can view images in their gallery one by one, in a large format.

FR10 - Instructions for using pEEp Learn

Even though we will aim to make the interface as obvious and uncluttered as possible, we will still provide information about how to use our model. Specifically, we will need to provide users information about the steps required to classify an image. Additionally, it is very important that we also tell users how to interpret the results of the classification, so that they can know how much they should trust the prediction.

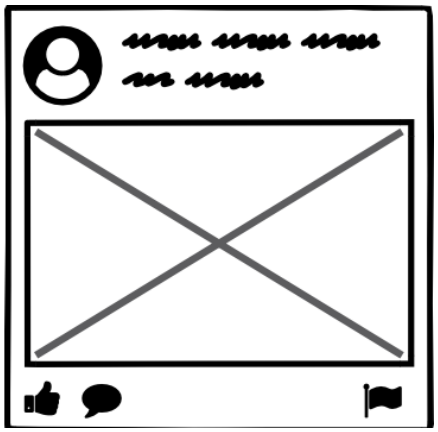
FR11 - Post images in the forum

Our user will have the access to upload the picture in our community forum, through the backend framework, the system will connect the frontend and backend. Then the file that our user upload will be stored in the database, and the user can show the pictures that have been stored in the community forum so that other users can also see it and make some reviews of it. The image below shows an example of what the community forum might look like when users share their bird images.



FR12 - Comment on other's pictures

In order to support our clients goal of building the bird-loving community, users will be able to interact with one another via their shared images. They will be able to comment on any image that appears on the community forum, as well as "favorite" another person's image. The "favorite" button will allow users to interact with each other and act as if someone commented "Great pic!". Taken from the image above is a closer look on the design aspect of how a user can like or comment on another person's image.



FR13 - Non-member forum access

Because we want our website to be highly accessible to everyone who wishes to use our application, we will not require accounts to be set up. However, non-members will have somewhat limited access. Users that have not yet created an account will be able to see the community forum but they will not be able to like, comment, or post any photos without creating an account.

FR14 - Expert access to the pEEp community forum

In order to enhance the scientific function of our website, we will give bird-related experts access to our pEEp community forum, where they can post their knowledge about birds, such as how to raise them, observe them and identify them. Experts can also interact with other users, such as solving some of their problems or providing them with information about birds.

FR15 - User contributed classifications

As aforementioned, the Educational Toolit will initially support classifications for only three (3) bird species. In order for this capability to expand, we need to allow users to classify birds themselves, specifically birds that belong to species that are not yet supported. To do this, we will need to add an additional feature on a webpage dedicated

to viewing images in the gallery that allows users to classify the image with the species they believe the bird belongs to.

FR16 - Verifying user classifications

Because pEEp aims to be an educational platform, it is expected that not all users are experts at identifying different bird species. Given this expectation, we should provide a verification step before we add any user classified images to the data set from which we train the CNNI. To do this, we will need to have a set of expert reviewers that have special permissions to the webpage described in the following FR.

FR17 - A dedicated page for expert review

Given that the amount of user classifications could grow significantly as the pEEp user base expands, we will need an efficient interface where experts can quickly review user classifications and correct them if necessary. This page will look similar to the image interaction page that all users can see, but instead will present the image, the user's classification, and provided buttons for confirming or correcting the classification.

FR18 - Sending out verified data

The images will be served from the backend, but as experts confirm or correct these user classifications, these verified information will be stored on the client side, so as to avoid unnecessarily excessive message passing between the frontend and the backend. After an expert is done with a session, there will be an option for them to submit the verified data to be appended to the database.

FR19 - Retraining the CNN

Once the user classified images are in the pEEp data set, we will need to set a threshold that will tell us whether or not we have enough examples to retrain the CNN to detect a new species. The backend will periodically poll the data set to see if the threshold has been reached for any species not currently supported. If the threshold has been reached for a given species, we will re-do the training of the CNN on the backend, and subsequently replace the current version of the CNN with the newly trained version. In addition to retraining the CNN, we will need to update the list of species currently supported.

4.4. Non-functional Requirements

Non-functional Requirements (NFRs) serve to describe the expected qualitative features of the functional requirements. Also referred to as performance requirements, NFRs determine **how** the system will behave, in contrast to the FRs determining **what** the system will do. In the context of our web-application, much of the NFRs described below

will relate to the security, reliability, speed, and usability of the website and its core features.

- **DR1** - Minimal learning curve
  - **NFR1 -** Our user interface will provide users with an easily navigable web application.
- **DR2** - Personal accounts
  - **NFR2 -** User profiles will provide a way for other users to learn more about the people they are interacting with.
- **DR3** - Customizable account settings
  - **NFR3 -** The configuration for accounts will be accessible from anywhere on the site.
- **DR4** - Efficient website uploads
  - **NFR4 -** The upload of images will be easy to understand and use.
- **DR4** - sharing images with others
  - **NFR5 -** Users can share any images they like with other users so that they can discuss with each other.
- **DR5 -** Educational tools
  - **NFR6 -** The Educational Toolkit will be easy to understand and use.
  - **NFR7 -** Predictions made by the Educational Toolkit shall be correct 90% of the time (at a minimum).
  - **NFR8 -** pEEp Learn will be readily extensible, increasing detection capabilities as the pEEp data set expands.
  - **NFR9 -** Each iteration of pEEp Learn will be highly testable and verifiable, so accuracy of any given version will be known before deployment.
- **DR6** - Platform to connect
  - **NFR10 -** Posting to the pEEp community forum, as well as commenting on past posts, will be straightforward to understand, and provide minimal logistical overhead when users wish to connect with each other.
- **DR7** - Mechanism to contribute
  - **NFR11 -** The personal classification option for images will be obvious on the image interaction page.
  - **NFR12 -** Users who classify their own images will be able to select from a list of species which have already been classified, or provide their own label for the species.
  - **NFR13 -** Expert reviewers will be able to approve a classification with one click, and automatically move to the next image that needs review.
  - **NFR14 -** Expert reviewers will be able to reject a classification if the image provides insufficient information to fully identify the bird.
  - **NFR15 -** Expert reviewers will be able to modify a classification with one click and some keyboard input, then be able to submit the modified classification with one click.

NFR1 - Easily navigable

Our user interface will be intuitive so that users can quickly and easily find the information they are looking for. To verify the usability of our user interface, it should take a user no more than 15 minutes to understand how to operate the web application and utilize the core features provided.

NFR2 - Learn about others

The basic biographical information in the user profiles will provide an additional way for users to learn more about, and better connect with, each other. This biographical information will be viewable by clicking on a user's profile.

NFR3 - Accessible configuration

As stated previously, expanding the community is one of our clients goals. In order to do so, we will provide access for creating an account and/or logging in on every page of the site. Because we want the site to be easily navigable, the user will be able to reach the pages within two clicks. Additionally, the signup page will provide all necessary information and settings for configuration on the single web page. This will ensure that the sign-up process is as smooth and fast as possible.

NFR4 - Efficient image uploads

In our web app, it will be very easy to upload your photos, you will be able to upload any number of photos, any size. Our database will store them as quickly as possible to give you the best experience. It's as easy as uploading pictures on Facebook or Instagram.

NFR5 - Connect with others

As an interactive website, you will be able to share and exchange your bird photos with others easily.Just post your favorite photos on our communication platform and other users will respond with comments. This also reflects the function of making friends on our website. As the number of users increases, you can get to know more bird watchers who share the same hobbies with you.

NFR6 - Easy way to learn

The Educational Toolkit, as aforementioned, will provide an interface for users to transparently use our trained CNN to predict the species of a bird within an image. To make this experience seamless, the image interaction page will be designed primarily to make classifications easy. This will be accomplished by having an image interaction page that is easily navigated to from all other pages on the site. Additionally, the image interaction page will be accessible by double-clicking photos from the gallery.

NFR7 - Prediction Accuracy

The CNN that we use for species classification must maintain a minimum accuracy threshold of 90% when predicting species. To test and verify this, we will randomly partition the pEEp data set that we use to train the CNN into three (3) sections: train, test, and validation. The training section will be used for the actual training of model parameters. The validation set will provide an unbiased evaluation of the model fit while tuning hyperparameters. The test set will provide unbiased feedback for the final, tuned model. This results from the test set evaluation will provide an accuracy measure, which is the final measure that must be, at least, 90%.

NFR8 - pEEp Learn will be extensible

The capabilities of pEEp Learn, i.e. the range of species which it can accurately identify, will be extended over time as the pEEp data set expands with user contributions. This capability of the system will be built in from the start, and will allow for an ever-improving educational tool for pEEp users.

NFR9 - pEEp Learn will be highly testable

Because the model we will use for predicting species will be the core feature of our pEEp Learn, we must subject the model to high standards in order for the toolkit to be truly effective. To accomplish this, we must rely on common metrics that measure the fit for a given model, and only deploy/redeploy a model if it passes all benchmark tests.

NFR10 - Straightforward forum access

To continue with the theme of making an application that seems natural to use, we want to provide a community forum that feels as close to a natural conversation as possible. To do this, we will make commenting on other posts incredibly easy, and ensure that a user can start a discussion with just 2 clicks and typing whatever message they wish to post.

NFR11 - obvious method for personal classification

As previously mentioned, we will need to rely on users to provide their own classifications in order to expand the range of birds which the model can identify successfully. To do this, we will provide an option in the image interaction page that will be large and obvious, and will allow the user to start the process of classifying an image themselves.

NFR12 - Species selection for personal classification

To aid in making the process for personal classification as painless and efficient as possible, we will display a text box for users to begin typing the species that they believe the bird in their image is, and we will filter options based on the current input. For

example, when the user begins typing, the text box will begin filtering the list of possible species based on what has been typed, making selection of species easy and efficient.

NFR13 - Expert approval of user classifications

The verification step for user classifications is crucial: the expansion of our model relies on new user classifications, but we must first ensure that the classification is correct so that it does not negatively affect the integrity of the model. To do this, we must provide a highly efficient interface where verified experts can review user classifications. In this interface, experts will be presented with several large buttons (that will have corresponding key bindings), one of which will be a 1-click classification approval button that will automatically cycle to the next image for verification.

NFR14 - Expert rejection of user classifications

The integrity of the model relies upon an excellent training set. In order to maintain this integrity, we should include only images of birds that are representative of the species. If the bird is excessively obfuscated in the frame, or if the bird has highly unique irregularities, then the image should be rejected and not added to the pEEp data set. Similar to the approval button, the 1-click (or 1-key tap) button for rejecting will automatically cycle the next image for verification.

NFR15 - Expert modification of user classifications

Of course, the whole motivation for expert verification assumes that users of the pEEp Smart Feeder are not all bird experts, and that sometimes they will incorrectly classify a bird they wish to submit to the data set. In such scenarios, the image of the bird might be perfectly representative of the species, but simply classified incorrectly. For experts to fix this classification, there will be a text box with the user classification, which will be open for experts to edit before selecting the approval button.

4.5. Environmental

For our project, there are minimal constraints imposed by our client. In general, we must build a web application that works with the current Android Box setup. Since we can think of the Android Box as essentially a phone, we can assume that web application access is as easy as selecting a browser and navigating to our domain. One feature that David would like, however, is the possibility for users to navigate through our website by using the directional pad on the Android Box remote. To do this, we will simply add keybindings for the arrow keys, and allow the user to switch between pages, select images, and use the pEEp Learn tools with arrow keys alone.

Regarding specific frameworks, technologies, programming languages, etc., our client has imposed very minimal restrictions. Because our client does not have a strong programming background, he felt more comfortable with the use of Python for a significant portion of the project, as the syntax and paradigms used by Python are extremely beginner friendly. Since we also wanted to use Python for efficiency, flexibility, and consistency, this requirement is, in essence, already fulfilled, as the frameworks that we are using have excellent support for Python.

5. Potential Risks

When developing a web application, it is important to consider the risks and problems that may arise. For our project specifically, there are a handful of risks primarily regarding usability and reliability.

Usability Risks

- Users won't be able to navigate the website easily.
  - Thus, we would need to understand why users are having difficulty, and how we can improve our design.
  - Having users not understand the website would result in users not utilizing our web application which would lead to a waste of time and money.

Reliability Risks

For any web application, security is always going to be a major risk. Specifically, this refers to the privacy of user photos and personal information. We will need to ensure that user photos stay private if the user has specified they want their photos private. If another user were to view a users private photo, this could impact the trust the user has for our web application. Leading the user to no longer use our application. This also ties in with making sure that our database is secure. We do not want people to be able to reach our database and potentially take other users photos or personal information. If someone was able to get into our database and gain access to a users' username and password, users would not feel secure knowing that their account and personal information can be reached.

One of the major reliability risks involves our AI model. Although the severity of this risk is still low, this is one of the major solutions we have for our client. The risks of our AI model is the confidence identification and analysis of bird species. Specifically, if the confidence level of the predicted bird species using the AI model is low, there is a potential for users to lose confidence in our web application. Following that, if the predicted bird species is inaccurate, there is a risk that users will no longer want to use the pEEp website to identify the birds they see in their backyard. Since pEEp is working to educate the bird-enthusiast community, it is important that we have a reliable and accurate AI model to identify the bird species.

Another reliability risk to consider is performance. The severity of this risk is not high considering the number of users starting out will most likely be low. But over time, it is crucial to know if our application can handle all the users that utilize it. As stated before, around 50 million people spend millions of dollars on bird-watching equipment, so there is potential for quantities of users.

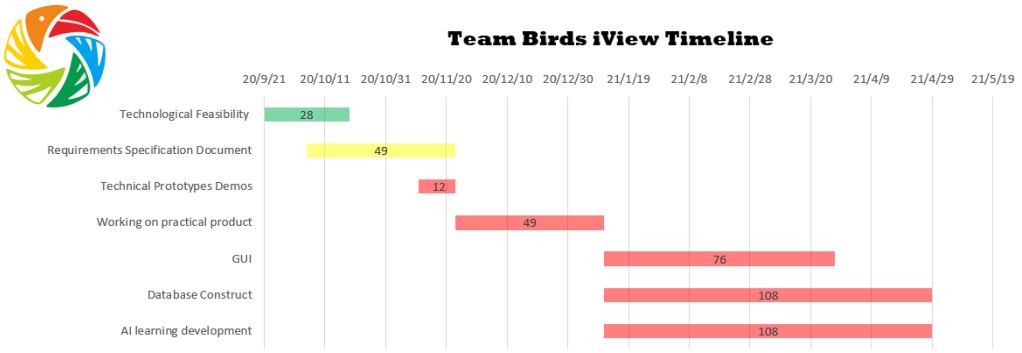
Additionally, connection failures may arise at any point while launching the application. Thus meaning, that possibly the front end is up and running but it cannot connect to the backend, or the backend cannot connect to the database or AI model. We will need to

have alerts to monitor the performance of our deployed web application. The impact of this risk is considerably high for anyone using the application during a connection failure. We will need to consider what will happen if a user is uploading a photo and all of a sudden the connection fails. How will this affect user experience? This could potentially lead to users no longer wanting to use the application if we do not address the problem in a timely manner. Since this can happen at any point, this is one of the more common risks of our application.

In conclusion, there are a variety of risks we need to consider and know how to handle. Every risk listed could lead to users not using the application which could negatively affect our clients products.

6. Project Plan

The timeline for development can be seen in the following Gantt chart:



The first major milestone in our development will be the initial integration of the individual prototypes of our database, frontend, backend, and AI module for the Technical Prototype Demo. This will be the alpha prototype for the pEEp website, and is scheduled to be complete by the end of the Fall 2020 semester (late November). After this initial prototype is up and running, we will work to fulfill the requirements enumerated above, focusing first on the major system components listed below:

- The base AI model that will be the foundation for pEEp Learn
- A database structure that can save images and provide access to them as needed
- A clean image interaction interface
- A transparent backend that acts as a proxy between the user and the database/AI components.

These core features will be developed in parallel during the Spring 2021 semester. After these core features have been developed, tested, and integrated, we will begin to implement the remaining components, which are more granular in nature.

Since we are first focusing on the major system components and then adding features to our core functions after, we will proceed in a way that prioritizes the core features that will make our project a success, and move on to the minutia only after these core features are solidified and tested.

7. Conclusion

Our client, David Plemmons, has a vision of both building a new online community of bird watchers, as well as strengthening the existing community of bird watchers. His current product, the pEEp Smart Feeder, allows people to engage in birdwatching without traveling or buying expensive gear. What is deficient in his current version, however, is the inability for people to share their findings with other pEEp members, as well as the inability for people to learn more about the birds in their images directly on the pEEp website. If these two major deficiencies are solved, then the pEEp Smart Feeder would provide a relatively inexpensive option for people to engage with nature and learn more about the birds in their yard, as well as connect with other people who have similar interests.

To solve these two major deficiencies, our team will build a web application that provides both educational tools as well as a platform for the bird watching community to interact with each other. The educational tools will be enclosed in the pEEp Learn toolkit, which will initially consist of a feature that will allow users to select one of their own images to be classified, and then provide a “best guess” as to what species the pEEp Learn tool thinks it is. This tool will provide a fast, convenient method for people to learn more about the birds in their yard, which is a great deal more exciting than reading about numerous bird species online without ever seeing or interacting with them. The other component that will be necessary in our solution is the community forum. In our current situation, people are more housebound than ever because of a worldwide pandemic, and this has greatly reduced our ability to interact with others. The community forum will provide an easy way for pEEp members to ask each other questions, share their experiences with the pEEp Smart Feeder, and, most importantly, provide an unconstrained way for people to build relationships with each other.

Through our requirements collection process, we first developed a comprehensive list of broad, domain-level requirements that represent the core features needed to make a successful product. We then enumerated all of the key functional and non-functional requirements that will be necessary to successfully deliver each domain-level requirement. These three classes of requirements that we have developed will serve as the definition of the application we will develop.

Lastly, there are certainly still some risks that would be detrimental to the success of our web application. We have done our best to list these risks so that we can be aware of any potential pitfalls that could arise in the future. These risks have been considered in our project plan, where we have allotted extra time to make sure these challenges can be addressed. The next phase will be development, where we may begin implementing features to address all the requirements considered here.

8. References

U.S. Fish and Wildlife Service. *Birding in the United States: A Demographic and Economic Analysis*. U.S. Fish and Wildlife Service, 2014-02-18, https://digitalmedia.fws.gov/digital/collection/document/id/1874.