PROJECT REPORT

Digital Naturalist - AI Enabled tool for Biodiversity Researchers

INTRODUCTION

Project Overview

A naturalist is someone who studies the patterns of nature, identifies a different kind of flora and fauna in nature. Being able to identify the flora and fauna around us often leads to an interest in protecting wild spaces and collecting and sharing information about the species we see on our travels is very useful for conservation groups like NCC. When venturing into the woods, field naturalists usually rely on common approaches like always carrying a guidebook around everywhere or seeking help from experienced ornithologists. There should be a handy tool for them to capture, identify and share the beauty to the outside world. Field naturalists can only use this web app from anywhere to identify the birds, flowers, mammals, and other species they see on their hikes, canoe trips and other excursions. In this project, we are creating a web application which uses a deep learning model, trained on different species of birds, flowers and mammals s (2 subclasses in each for a quick understanding) and get the prediction of the bird when an image is been given.

Purpose

The aim of this project is to identify the species in the forest and in other places, there should be a handy tool for them to capture, identify and share the beauty to the outside world.

LITERATURE SURVEY

Existing problem

The existing problem of this project is to carry a guidebook everywhere you go to identify organisms. Internet databases does not have an easier method to search through them. We need to manually go through them but using ai and advanced ml algorithms we can improve this problem.

References

PAPER-1

Convolutional Network based Animal Recognition using YOLO and Darknet (2021)

Authors: B.Karthikeya Reddy, Shahana Bano, g.Greeshmanth Reddy,Rakesh Kommineni, p.Yaswanth Reddy

This research work has developed a YOLOV3 model to identify the animal present in the image given by user. The algorithm used in YOLOV3 model is darknet, which has a pretrained dataset. Machine learning has been applied to image processing. The image of animal will be given as input, then it will display the name of the animal as output by using YOLOV3 model. The detection is done by using a pre-trained coco dataset from darknet. The image is broken into various lengths and widths based on the given input image. Here for the recognition of image, YOLOV3 model is using recognizer deep learning package. The overall performance of the model is based on the different training images and testing images of the dataset. The detection is done by using a pre-trained coco dataset from darknet.

PAPER 2

The Analysis of Plants Image Recognition Based on Deep Learning and Artificial neural network (2020).

Authors: Jiang Huixian

This paper aims to identify and classify the plant using the leaves of the plant. The approach is to extract plant leaf features and identify plant species based on image analysis. The plant leaf images are segmented and the feature extraction algorithm is used to extract leaf shape and texture features from leaf sample images. An artificial neural network classification method based on backpropagation error algorithm (BP algorithm) is proposed to recognize plant leaves. This paper studies the existing plant image location and recognition technology, and introduces deep learning theory. After that, the high dimensional expression of image features by artificial neural network in deep learning theory is analysed. The existing ANN model is improved and some new techniques and methods are introduced to construct a new ANN model. The model unifies the processes of image segmentation, target feature extraction and target classification.

PAPER 3

Ungulate Detection and Species Classification from Camera Trap Images Using Retina Net and Faster R-CNN (2022)

Authors: Gholamreza Anbarjafari, Ilja Pavlovs, Kadir Aktas ,Egils Avots, Jevgenijs Filipovs, Agris Brauns, Gundega Done, Dainis Jakovels, Gholamreza Anbarjafari

This paper presents a new dataset of wild ungulates which was collected in Latvia. It demonstrate two methods, which use Retina Net and Faster R-CNN as backbones respectively, to detect the animals in the images. Faster R-CNN–ResNet50 network and Retina Net were trained for 34,850 iterations (10 epochs) on the training dataset with a batch size of 4, learning rate of 0.0001 and Adam optimizer for the weight update. The general structure of the detector involves image embedding, object localization and classification. DNN consisting of convolutional layers which are used for the feature extraction from the input image. Usually, backbone networks which are pretrained on a natural image dataset such as ImageNet are used. Common networks used as the backbone are ResNet50, VGG160, Inception-ResNetV2 and DarkNet-19. The neck network takes and processes inputs from the different layers of the backbone, harnessing advantages of data pattern distribution over different feature map scales by using FPN (Feature Pyramid Network). A feed-forward neural network which performs the classification or regression task.

PAPER 4

Bird Image Retrieval and Recognition Using a Deep Learning Platform (2019).

Authors: Yo-Ping Huang, Haobijam Basanta

The authors have developed a deep learning platform that helps users recognize various species of birds endemic to Taiwan. A mobile application named the Internet of Birds (IoB) is developed that recognizes 27 species of birds. The deep learning model for bird image classification using the CNN framework is described. Bird images were learned by a convolutional neural network (CNN) to localize prominent features in the images. The model established and generated a bounded region of interest to refine the shapes and colours of the object granularities and subsequently balanced the distribution of birds. Then, a skip connection method was used to linearly combine the outputs of the previous and current layers to improve feature extraction. Then it applied the soft max function to obtain a probability distribution of bird features. The platform uses cloud based deep learning for image processing to identify bird species from digital images. The proposed system could detect and differentiate uploaded images with an overall accuracy of 98.70%.

PAPER 5

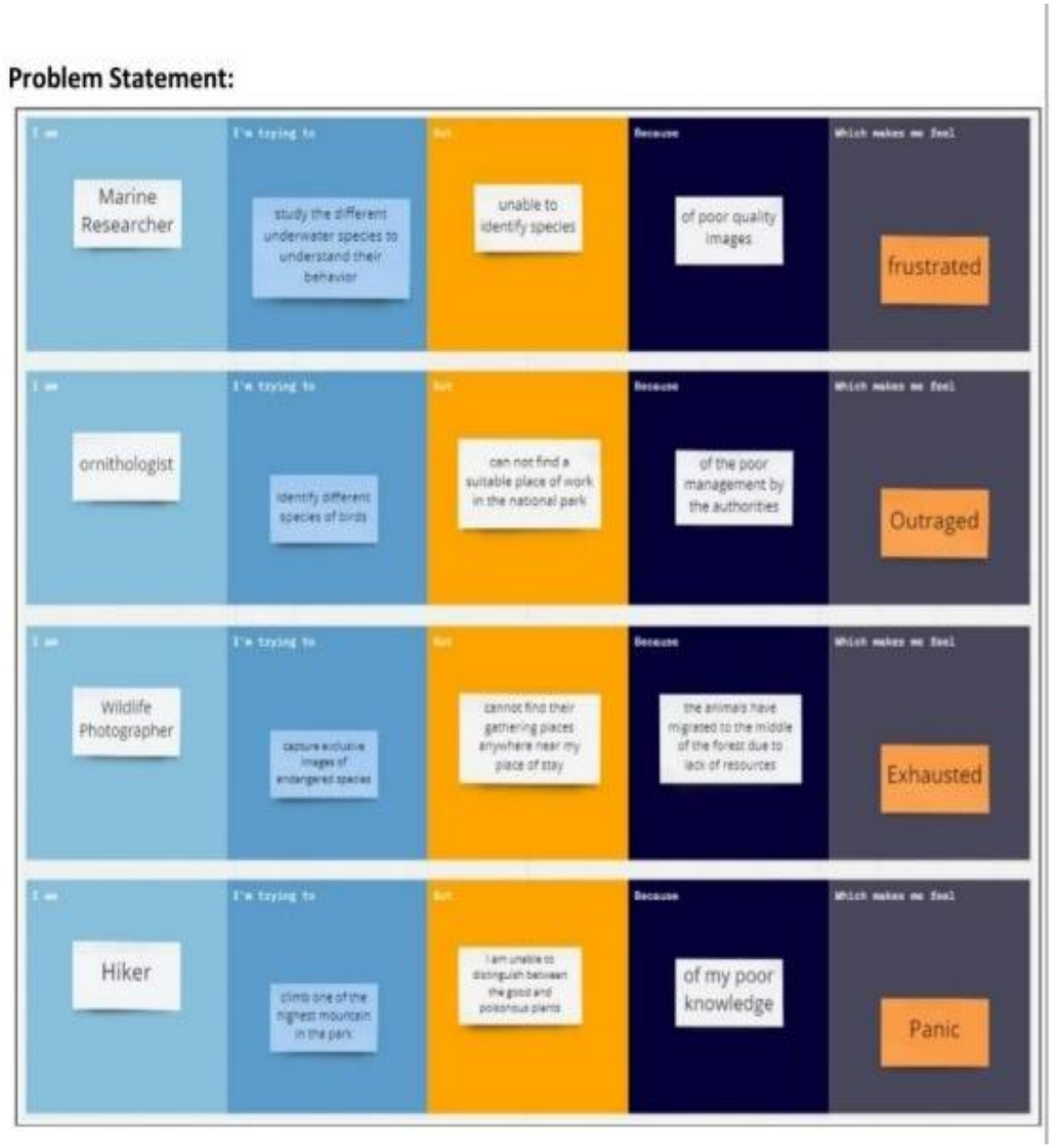
An Efficient Framework for Animal Breeds Classification Using Semi Supervised Learning and Multi Part Convolutional Neural Network (MP-CNN) (2019).

Authors: S.Divya Meena, L.Agilandeeswari

The paper focus on classifying 27 classes of animals with 35,992 training images. The proposed model classifies the animals on both generic and fine- grained level. It has built a semi supervised learning based Multi-part Convolutional Neural Network (MP-CNN) with a hybrid feature extraction framework of Fisher Vector based Stacked Autoencoder. With Semi-supervised learning based pseudo-labels, the model classifies

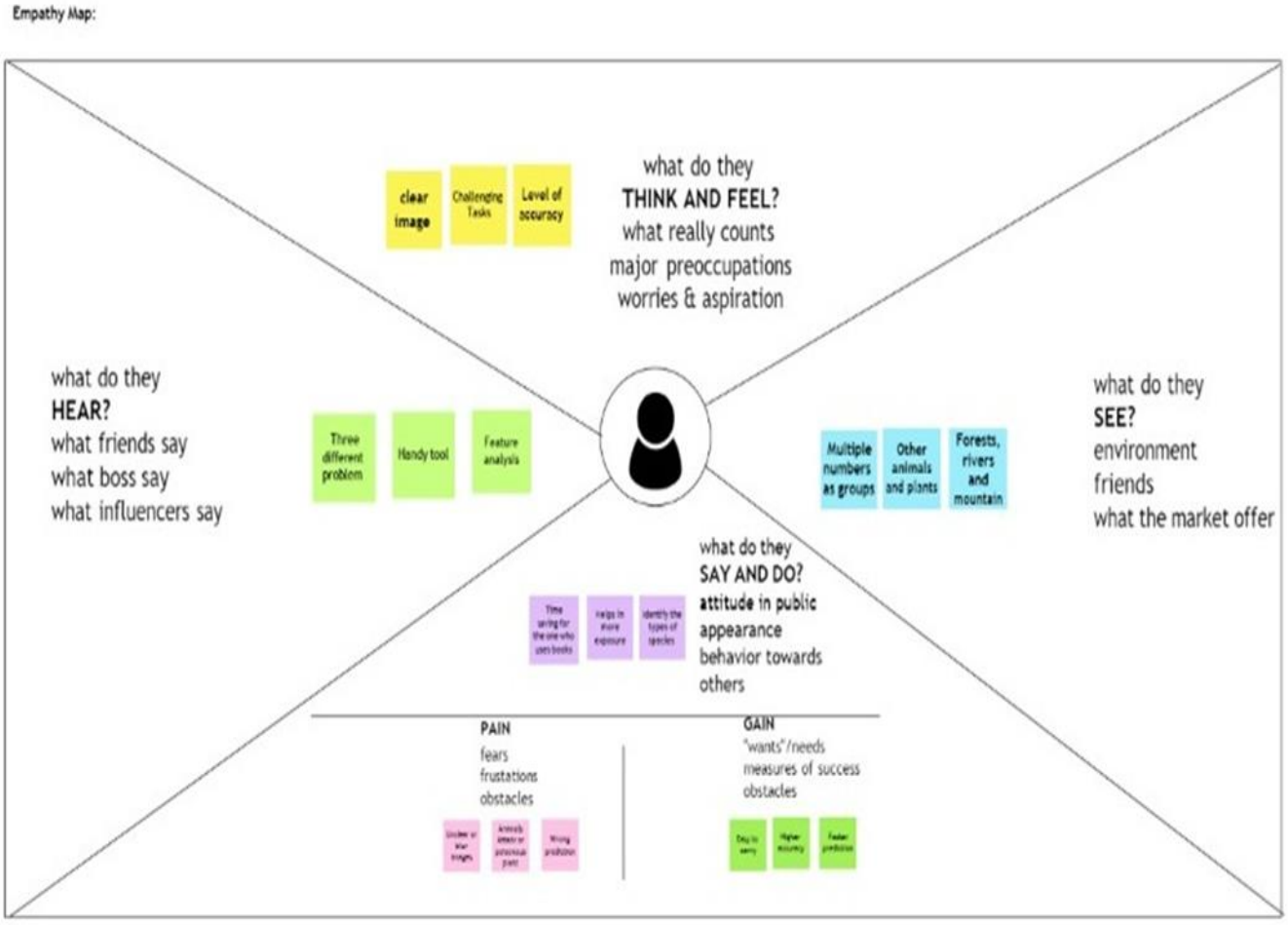
new classes of un labeled images too. Hellinger Kernel classifier method has been modified and used to retrain the misclassified classes of animals which further enhance the accuracy. Semi supervised learning based pseudo-labels, the model classifies new classes of unlabeled images too. The testing accuracy increases as the models get trained. The experimental results shows that the overall accuracy is 99.6%.

Problem Statement Definition



IDEATION & PROPOSED SOLUTION

Empathy Map Canvas



Template

Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare
1 hour to collaborate
2-8 people recommended

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

A **Team gathering**
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

B **Set the goal**
Think about the problem you'll be focusing on solving in the brainstorming session.

C **Learn how to use the facilitation tools**
Use the Facilitation Superpowers to run a happy and productive session.

Open article →

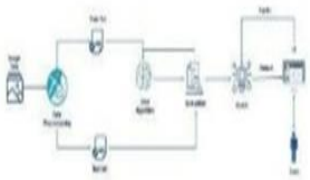
1 Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

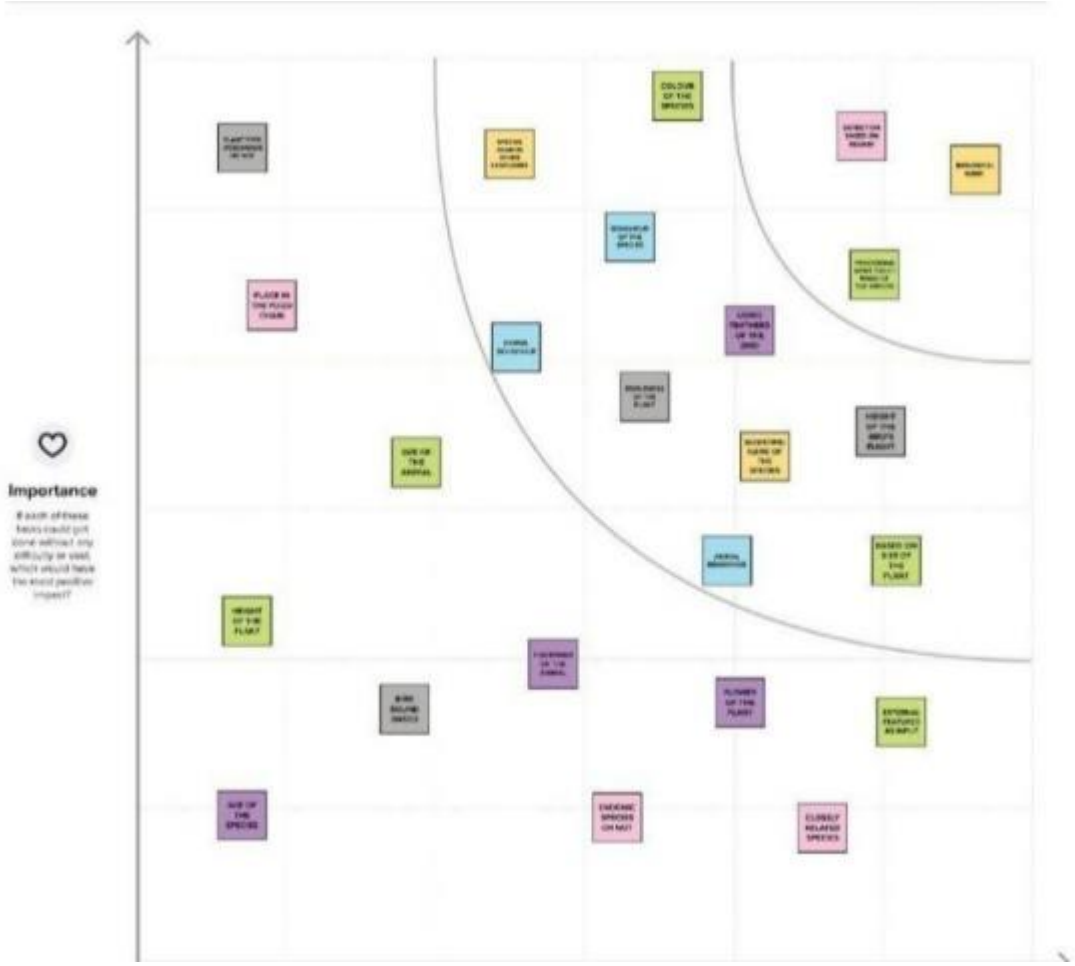
5 minutes

PROBLEM

To develop an web application capable of exploring and scan the species either flora or fauna at the same time and to displaying the details about the species to the user.




A KEERTHANA
G HARSHAVARTHIN
M J HARIDEEHA
A EVANJALI
Biological name of the species.
Animal behaviour
Species name in other languages.
Processing more than one images at a time.
Plant type poisonous or not.
Bird sound based.
Behaviour of the insects.
Based on the size of the plant.
Using feathers of the bird.
Detection based on region.
Size of the animal.
Fatherness of the plant.
Age of the species.
Height of the plant.
Scientific name of the species.
Endemic species or not.
Closely related species.
External features as input.
How it behaves
Colour of the species.
Height of the birds flight.
Foot print of the animal.
Place in food chain.
Flower of the plant.
BASED ON NAME
Biological name of the species.
Species name in other languages.
Scientific name of the species.
BASED ON BEHAVIOUR
Animal behaviour
Behaviour of the species.
How it behaves
BASED ON FEATURES
Using feathers of the bird.
Age of the species.
Flower of the plant.
Foot print of the animal.
BASED ON APPEARANCE
Based on the size of the plant.
Height of the plant.
Size of the animal.
Colour of the species.
External features as input.
BASED ON SURROUNDINGS
Detection based on region.
Closely related species.
Place in food chain.
Endemic species or not.
BASED ON NATURE OF THE SPECIES
Height of the birds flight.
Bird sound based.
Fatherness of the plant.
Plant type poisonous or not.


Importance

Proposed Solution

S No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To identify a species in a forest or in any other place, we need to carry a heavy book or seek a professional.
2.	Idea / Solution description	A Web Application that is trained with CNN using deep learning model on different species can replace such big books.
3.	Novelty / Uniqueness	The model can identify different species of plants, birds and animals.
4.	Social Impact / Customer Satisfaction	Customer can identify the type of species faster and easier without searching in books page by page.
5.	Business Model (Revenue Model)	The model can differentiate the species at a faster rate with better accuracy.
6.	Scalability of the Solution	The web application apart from researchers can also be used by students and common people .

Define CS, fit CC

1. CUSTOMER SEGMENT(S) CS

1. Experience professionals and Inexperienced people who are willing to learn about bio diversity.
2. People who go for hikes or trips to the forest areas and mountains.
3. Amateurs or Students or people who like to learn more about the biodiversity.

6. CUSTOMER CONSTRAINTS CC

1. No knowledge about bio diversity.
2. Cannot remember everything.
3. Not able to identify the plants and animals

5. AVAILABLE SOLUTIONS AS

1. Field naturalists always carry a guidebook around everywhere or seeks help from experienced Ornithologist.
2. Get help from experienced people.
3. Internet and other apps

Explore AS, differentiate

Focus on J&P, tap into BE

2. JOBS-TO-BE-DONE / PROBLEMS J&P

1. Fear of misidentification.
2. Need to know about at least the basics.
3. No knowledge or experience about bio diversity as the user is just starting to learn which can lead to confusion

9. PROBLEM ROOT CAUSE RC

1. Need to depend on experts like Ornitologists, Zoolagists, Botanist.
2. Users may not be a naturalist or just a student who just started to learn so they may not know any information.
3. Too much data cannot be stored by any human or they may forget or other due to any other problems like age.

7. BEHAVIOUR BE

1. Carry guide books or other notes to identify species.
2. Get help from experienced professionals
3. Try to remember the species based on its feature.
4. Plant identifier.
5. Animal identifier

Focus on J&P, tap into BE

Identify strong TR & EM

3. TRIGGERS TR

They hear about new app with best features by their friend or colleagues, or read about appin news, or search the internet on their own.

4. EMOTIONS: BEFORE / AFTER EM

1. Before: Feel very sad to carry book always. They may hesitate to task help from experts Sometime feels shame to ask help from experts

After: Feels happy no need carry heavy books. Feel proud because no need to seek help from experts.

10. YOUR SOLUTION SL

1. All information should be available in on application.
2. Display Botanical names .
3. Display alert messages for plants/animals using different colors .
4. Small description about them .
5. Rarities of the species

8.CHANNELS of BEHAVIOUR CH

ONLINE

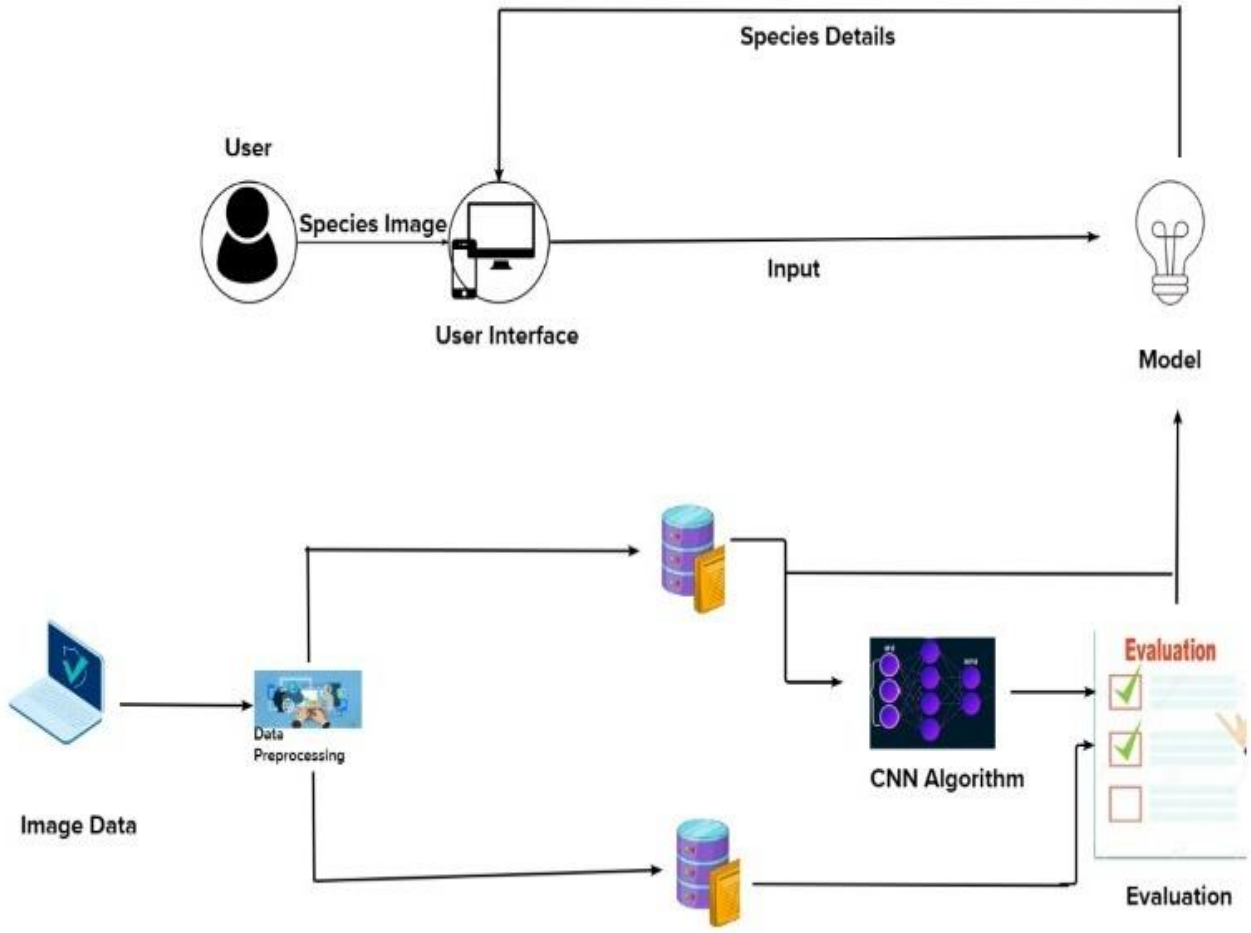
1. All features are accessible during online.
2. Search using the internet about the species

OFFLINE

1. Get help from friends or professionals.
2. Guidebook or they even take their own notes

Extract online & offline CH of BE

Solution Architecture



REQUIREMENT ANALYSIS

Functional requirement

Following are the functional requirements of the proposed solution.

FR No	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Google API
FR-2	User Confirmation	Confirmation via Email and OTP
FR-3	Transactions	Through UPI, Credit/Debit cards and Net Banking.
FR-4	Authentication	Through OTP sent to mobile. User created secured passwords.
FR-5	Authorization	Basic Authorization
FR-6	Administrative functions	Adding, Updating and Maintaining description data about various species.
FR-7	External interfaces	Easy to access UI and Community for discussions

Non-Functional requirements

Following are the non-functional requirements of the proposed solution

FR NO	Non-Functional Requirement	Description
NFR-1	Usability	Our solution is demanded for scientific researchers Such as Ornithologists , Zoologists in order to predict and analyse about flora and fauna.
NFR-2	Security	Authentication process involves multilayer security to make user data and collected data more secured, also to avoid unknown authorization and data integrity issues. Most security methods include Encryption and Authorization.
NFR-3	Reliability	Our framework should be reliable to cover wide range of species spanning across various habitats.
NFR-4	Performance	Data Augmentation to increase dataset size along with transfer learning to increase accuracy and performance for better working of application.

NFR-5	Availability	Our application possess full-time service (either offline or online) and dataset is constantly updated.
NFR-6	Scalability	Our application supports large number of concurrent users without any hurdles or errors through scaled cloud resources.

PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Evanjali A
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application.	2	Low	Harideesha MJ
Sprint-1	Login	USN-3	As a user, I can log into the application by entering email & password.	1	Medium	Harshaa vartini G
Sprint-1		USN-4	As a user, I can upload the image to identify the species.	3	High	Keerthana A
Sprint-1	Dataset collection	USN-5	Datasets are collected to train the model.	2	High	Evanjali A
Sprint-2	Data Pre-processing	USN-6	The data is loaded and Pre-processed to train the model.	4	High	Harideesha MJ
Sprint-2	Build and Train the model	USN-7	The model is trained using Training dataset.	8	High	Harshaa vartini G

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Evaluate the model	USN-8	The model is evaluated.	6	High	Keerthana A
Sprint-3	Create Application	USN-9	Application is built using Python Flask.	8	Medium	Evanjali A
Sprint-3	Load the model	USN-10	The model is loaded into Python Flask.	6	High	Harideesha MJ
Sprint-4	Species identification	USN-11	As a user, I can view the species details.	6	Medium	Harshaa vartini G
Sprint-4	Logout	USN-12	As a user, I can logout of the application.	2	Low	Keerthana A

Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	10	6 Days	24 Oct 2022	29 Oct 2022		29 Oct 2022
Sprint-2	18	6 Days	31 Oct 2022	05 Nov 2022		
Sprint-3	14	6 Days	07 Nov 2022	12 Nov 2022		
Sprint-4	8	6 Days	14 Nov 2022	19 Nov 2022		

Reports from JIRA

Velocity:

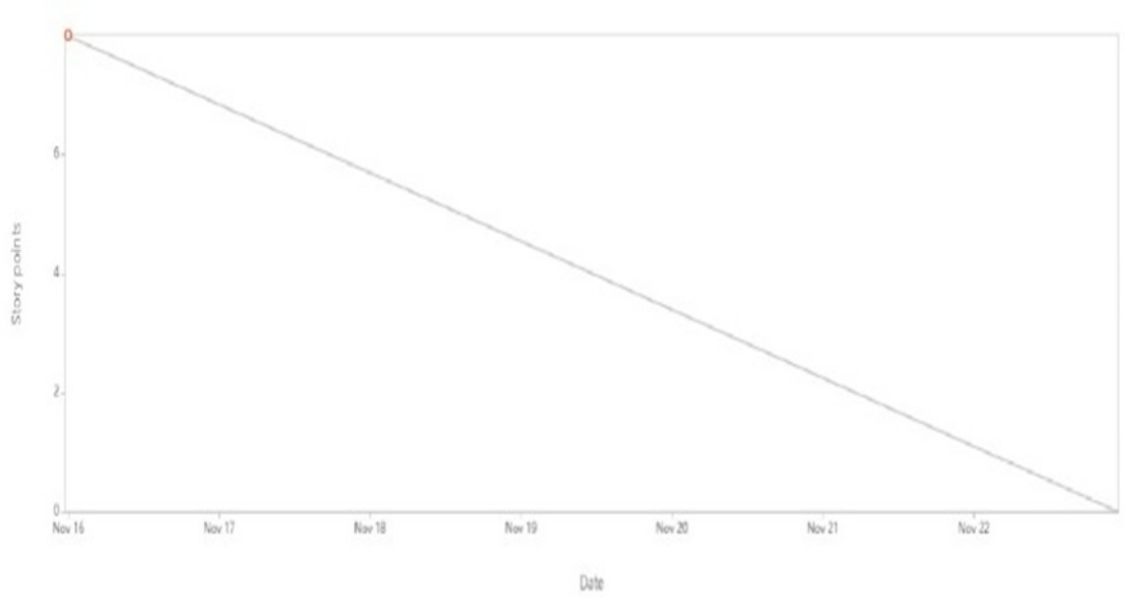
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

Average velocity = 9/4 = 2.05

Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

Burndown chart:



CODING & SOLUTIONING

Feature 1

A CNN-based model which is trained up with the help of a pre-stored dataset of different species and performs with a high accuracy in predicting any new given restricted data to the model and the response/output from the model is delivered through a webpage for the user. Genuinely the model runs on a cloud platform called "IBM cloud" where the input files (i.e) dataset that are necessary for the model to predict properly are stored in the cloud as like the model itself. We used inception net pretrained network to train the model which helps in avoiding the overfitting issues and for efficient computation as well. It is then integrated with the flask application to allow the user to give input image-file to the model via a webpage in order to get knowledge about the species that they are looking for.

Feature 2:

A feature called upload option which is present in the webpage for the purpose of delivering the input image-file from the user to the model for the computation purpose of finding out what exactly the species is. This feature is linked up with a function from flask application whereby when a user clicks on this very upload button then the uploaded image-file is taken to the model where the image-file is stored locally and turned into an image array before the actual computation process begins and later sending back the response/output to the webpage for user's view.

TESTING

User Acceptance Testing Introduction:

Effectively documenting incidents during the testing process is the key to improving software or processes before a system is released. Sometimes, the testers themselves document issues they encounter; but more often, a UAT coordinator verifies, consolidates, and classifies reported issues before assigning them to the appropriate group to address. Then, that IT coordinator again validates and prioritizes the technical issues before handing them off to an IT developer to investigate further and resolve. During the course of UAT, it is inevitable that issues will be discovered. It is shocking how often documented issues contain insufficient data to facilitate a quick and thorough investigation.

Deliverables of UAT:

Every interviewer very quickly stated that UAT is to assure quality. Project managers also stated that it can double as a training exercise for business users as well as ensuring that the requirements set match the functionality that is desired from the system. People managers expressed that one of the most important deliverables is the decision to go forward with the update or new system; the ”green” or ”red” light. Individual contributors expressed that UAT and inclusion goes hand in hand. That the testers feel included in the development and actually have a say in what works and what doesn’t. Individual contributors stated that they felt that UAT has been done enough when the tests they are running are all success full but that it is a gut-feeling or intuition that says when they are content with the testing. They also stated many perks of UAT such as: learning the new system, cooperation between departments, learning something new, feeling valued by the company and inclusion in decision making. Project Managers stated that the organization at large sometimes acted as though it had forgotten the purpose of UAT - to assure quality and usability of a release.

Data Mining:

This section represents the actions pillar of the research. Here results based on empirical insights from the system log files are presented. Results from the qualitative review of the testers use of test management tools are also presented in this section.

Time spent on Testing:

Because access was granted to the SUTs application logs it was possible to track exactly how much time users spent on testing functionality in the system. In the blow table 4.3.1 average times are detailed some of the users from the SUT.

Test Quality:

As transition matrices for both TEST and PROD had been computed, a similarity score could be computed to directly and in bulk estimate the quality of the testing. From the production logs of the SUT a Markov-chain with 68 states(one for each application feature that was left after filtering out non-relevant states) was created. Due to the fact that the SUT was a regular release of an existing system, and not a newly adopted software, a transition matrix could

be made on a per-tester level for both the production system logs, as well as the test system logs. Variability due to changes in logging were taken into account by qualitatively examining the log files.

Execution Flow

- C program (source code) is sent to pre processor first.
- Expanded source code is sent to compiler which compiles the code and converts it into assembly code.
- The assembly code is sent to assembler which assembles the code and converts it into object code.

Usually, when possible, this testing happens in a conference or a war room sort of a set up where the users, PM, QA team representatives all sit together for a day or two and work through all the acceptance test cases. Once all the tests are run and the results are in hand, the Acceptance Decision is made. This is also called the Go/No-Go decision. If the users are satisfied it's a Go, or else it's a No-go. Reaching the acceptance decision is typically the end of this phase.

Conclusion:

UAT is not about the pages, fields or buttons. The underlying assumption even before this test begins is that all that basic stuff is tested and is working fine. God forbid, the users find a bug as basic as that – it is a piece of very bad news for the QA team. This testing is about the entity that is the primary element in the business.

```
1  class Program
2  {
3  static async Task Main(string[] args)
4  {
5    WriteLine("Please type the username for the desired user:");
6    var username= ReadLine();
7
8  var github new GitHubClient(new ProductHeaderValue("MyAmazingApp"));
9
10 try
11 {
12   var user= await github.User.Get(username); WriteLine($"The user (user.Name) was
         succesfully retrieved!"); WriteLine($" (user.Name) has (user. PublicRepos}
         public repositories. Do you want to see the list? (y/n)"); var response =
         ReadLine();
13
14   if (string.Equals(
15     "Y",
16    response,
17    StringComparison. InvariantCultureIgnoreCase))
18   {
19     var repos avait github.Repository.GetAllForUser(username);
20     foreach (var repo in repos.OrderBy(x => x.CreatedAt))
21     {
22 WriteLine($" (repo.CreatedAt:yyyy-MM-dd) | (repo.Name)");}
23
```

RESULTS

Performance Metrics

COLLECTION OF PERFORMANCE MEASUREMENTS

Managing application performance requires the continuous collection of data about all relevant parts of the system starting from the end user all the way through the system. This collected data is the basis for getting a holistic end-to-end and up-to-date view of the application state including the end-user experience. In this chapter, we will discuss what data to collect, and from where and how to collect the data in order to achieve this view Most application systems are implemented in a way that, in addition to the application logic executed at the provider's site (Referred to as the back-end), parts of the application are executed at client site. The client site usually constitutes a system tier accessing the back end

EXTRACTION OF PERFORMANCE-RELEVANT SYSTEM INFORMATION

The previous chapter focused on the collection of performance measurements from the relevant locations of the application system. This chapter focuses on the representation of higher the application system. While time series represent summary statistics (e.g., counts,

percentile, etc.) over time, execution traces provide a detailed representation of the application-internal control flow that results from individual system requests. From this data, architectural information, including logical and physical deployments and interactions (topology), can be extracted. For all cases, we will highlight examples and use cases in the context of APM level performance-relevant information about the system and their end-users that can be extracted from this data and that is used for APM visualization and reasoning, as detailed in the next chapters. Notably, we will focus on three commonly used representations, namely time series, execution traces, and augmented information about the architecture. When depicting the number of users accessing a system, time series usually show a periodic pattern, e.g., based on the weekdays and the hours of the day. Other interesting patterns are spikes, for instance, indicating peaks in workload or hiccups.

EXECUTION TRACES

We concluded the previous section with the statement that time series are not suitable for analyzing individual requests. A data structure commonly used in APM for this purpose is an execution trace. Informally, an execution trace is a representation of the execution flow of a request through the system–ideally starting from the end user. As an example, Figure 3 depicts a schematic execution trace. The execution trace starts with an operation called do Filter that is commonly found as an entry point in web-based applications. It can be observed that the execution of the do Filter operation includes a sequence of additional nested operation executions, until the list operation performs a sequence of calls to a database.

ADVANTAGES & DISADVANTAGES

Advantages:

This system allows us to Identify and learn more about species automatically once an input is given. The input image is fed into a CNN which automatically analyses and produces a prediction. his project can be accessed from anywhere through the internet thus making our project portable.

Disadvantages:

The current web app is not approximately scaled and hence won't be able to handle high traffic. Since the dataset used is not of wide variety, we will not be able to detect a wide variety of species.

CONCLUSION

In this project, we have deployed a website where we can upload an image of restricted set of species and the website will browse through thousands of images and will find every information it can regarding the being in the database.

FUTURE SCOPE

This application can be scaled widely to include a wide variety of species and also live detection systems placed in various places in areas where wildlife is widely present can be used to track and observe wildlife and help protect them.