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# 1. Introduction

## A. Project Overview

In this project, we are creating a web application which uses a deep learning model, trained on different species of birds, flowers and mammals (2 subclasses in each for a quick understanding) and get the prediction of the bird when an image is been given. The existing solution is quite simple and suits certain constraints whereas we need to find alternatives to retrieve a more comprehensive range of information. The identification algorithm is fit in a mobile app which makes it platform independent. The web version of the mobile app is linked with the database portal with which a researcher can access the data. This app is architected to withstand high volumes of traffic. The capability of the app to find various flora and fauna is improvised. The identification database can be updated easily.

## B. Purpose

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.

# 2. Literature Survey

## A. Existing Solution

Existing solution for the problem is available in the form of internet options like google lens and apple lens. These tools however are not designed for the particular purpose of finding and distinguishing the flora and fauna. With so many objects for them to detect and identify, the existing solutions are not optimised to perform a single task, thereby reducing the accuracy of the detection and identification.

## B. References


1) Ungulate Detection and Species Classification from Camera Trap Images Using RetinaNet and Faster R-CNN (2022)
**Published**: 09 February 2022
**Link**:
https://www.researchgate.net/publication/358939019_Ungulate_Detection_and_Species_Classification_from_Camera_Trap_Images_Using_RetinaNet_and_Faster_R-CNN
**Points we take**: Incorporating machine learning into ecological workflows could improve inputs for ecological models and lead to integrated hybrid modelling tools.
**Methodology:** Convolutional Neural Network (CNN),Tensorflow Framework, Back Propagation

2) "Image Classification Using Deep Neural Network". Tiwari, Vaibhav, Chandrasen Pandey, Ankita Dwivedi, and Vrinda Yadav.In 2020 2nd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN), pp. 730-733. IEEE, 2020.

**Published**: 2020

**Authors** :Tiwari, Vaibhav, Chandrasen Pandey, Ankita Dwivedi, and Vrinda Yadav

**Link**: https://www.semanticscholar.org/paper/Image-Classification-Using-Deep-Neural-Network-Tiwari-Pandey/61cbf797a48abe2864d9ba6f852a5988f46e7abe

**Points we take**: The recognition can be performed using images of different organs of the plant,flower in a real-time application. We get some inspiration from their experience of that application.

**Methodologies**: Deep Neural Network, VGG, Image Classification, CNN

3) "Rare Animal Image Recognition Based on Convolutional Neural Networks" .Hao, Xinyu, Guangsong Yang, Qiubo Ye, and Donghai Lin. In 2019 12th International Congress on Image and Signal Processing, BioMedical Engineering and Informatics (CISP-BMEI), pp. 1-5. IEEE, 2019.

**Published**: 2019

**Link**: https://ieeexplore.ieee.org/document/8965748

**Points we take**: Avoiding the cumbersome process of manual preprocessing for the target image, and can directly input the original image for recognition, which is more feasible than the traditional image recognition algorithm.

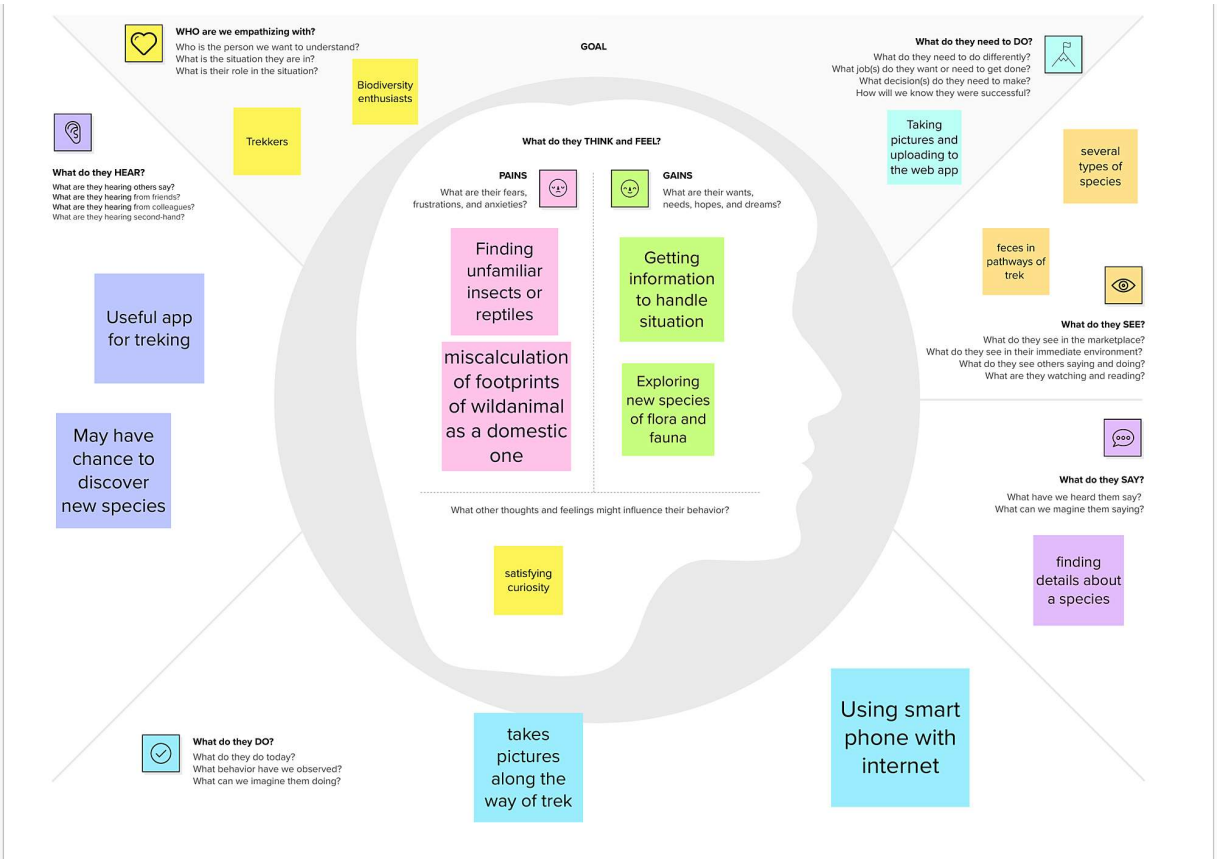
**Methodology:** Convolutional Neural Network (CNN),Matrix Multiple CNN (MMCNN)

# C. Problem Statement Definition

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 (2 subclasses in each for a quick understanding)and get the prediction of the bird when an image is been given.

# 3. Ideation & Proposed Solution

## a. Empathy Map:



# b. Ideation and brainstorming:

We have brainstormed with our group for this project and contracted to three top ideas those are:

1.) We are going to specifically concentrate on the variety of animals and plants data it would be more useful for research and educational purpose where they can particularly set what kind of information the user wants,our application displays scientific names of the plants and animals where user can switch from Latina names to common names for better understanding.

2.) Our application is also capable of identify animals by their footprints and skin sheds, identify plants by their leaves and flowers because every flora and fauna have a unique pattern which make us easy to identify.

3.) The unidentified creatures , plants or their patterns can be separately noted in our application so that it can be researched thoroughly afterwards,user can suggest their discoveries to us which will be verified and updated in our application.

# c. Proposed Solution:

## Novelty (Originality of the idea):

- The existing solution is quite simple and suits certain constraints whereas we need to find alternatives to retrieve a more comprehensive range of information.
- The stakeholders also find it hard to work on customizing factors in the whole information system.
- The identification algorithm is fit in a mobile app which makes it platform independent.
- This app is made to detect the various flora and fauna and the soil type which is one in a kind.

- The web version of the mobile app is linked with the database portal with which a researcher can access the data.

## Business Model

- The web app is billed with a subscription model.
- There will be two subscription models, One is a basic plan and another one is an admin plan.
- The Basic plan allows the researchers to access only the flora and fauna recognition capabilities.
- The admin plan allows the researcher to access the database regarding the various scans they have performed.
- This model makes sure that a large amount of the customer base is covered which might include students, teachers, and researchers.

## Scalability

- This app is architected to withstand high volumes of traffic.
- The variation in the subscription model scales the app for a wider audience.
- The capability of the app to find various flora and fauna can be improvised.
- The identification database can be updated easily.

# d. Problem Solution Fit:

**Project Title: Digital Naturalist**
**- AI Enabled tool for Biodiversity Researchers**

**Project Design Phase-I - Solution Fit**

**Team ID: PNT2022TMID20804**

Define CS, fit into CC

**1. CUSTOMER SEGMENT(S)** CS

1. Zoologists
2. Paleontologists
3. Wildlife Photographer
4. Botanist

**6. CUSTOMER CONSTRAINTS** CC

1. Availability of information about flora and fauna from a single source
2. Remember all the massive information about flora is difficult
3. Writing down the new information on the site for research purposes

**5. AVAILABLE SOLUTIONS** AS

1. Searching in Encyclopedia
2. Asking the Locals
3. Searching in the internet
4. Studying about native species from state government tourism portal

Explore AS, differentiat

Focus on J&P, tap into BE, understand RC

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

1. It is important to know information about flora and fauna that is in our native and the places where we visit
2. If their is a recognition software to differentiate flora and fauna it would be useful

**9. PROBLEM ROOT CAUSE** RC

1. Very little information about plants and animals that are living in our locality
2. Lack of information on these plants and animals

**7. BEHAVIOUR** BE

1. Whenever they need information they can access the portal and clarify their doubts regarding the species they have came across
2. They can browse the portal whenever they are free and learn about new and exiting things

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

**3. TRIGGERS** TR

1. Having trouble to classify the animals whether it is carnivore, herbivore, omnivore
2. Being not able to determine the particular plant or animal is poisonous or not

**4. EMOTIONS: BEFORE / AFTER** EM

- Before:
  1. Less Knowledge on flora & fauna
  2. Confusion in determining the plants & animals
- After:
  1. More Knowledge on flora & fauna
  2. No more confusion

**10. YOUR SOLUTION** SL

1. The main aim is to create a recognition software using supervised learning which take the image of the flora and fauna as and give their latin names and commonly used names as an output to the users

**8. CHANNELS of BEHAVIOUR** CH

**8.1** ONLINE

1. Whenever they need to know information they can access the online resources to clarify doubts

**8.2** OFFLINE

2. They can write their new discoveries offline when they researching and can later update whenever they want

Identify strong TR & EM

# 4. Requirement Analysis

## a. Functional Requirement:

The main need for functional requirement is to have functionalities for the input and output classification. The major functional requirement for our project are:

- **Administrative functions**

The main need for administrative functions is to divide the CRUD operations based on the users using the application. This helps to differentiate who has which CRUD operation available to use for them and also defines the ability to access database for different users.

- **Authentication**

Authentication is used by a server when the server needs to know exactly who is accessing their information or site. Authentication is used by a client when the client needs to know that the server is system it claims to be. This helps us to monitor who uses the application and helps us to maintain the security and authenticity of the application that the user is using. This also helps the users to manage all the species that they have scanned.

- **Authorization levels**

The owner has full access rights to the access the user data and can grant other people the right to access it. You say that the owner authorizes people to access it. This simple example allows us to introduce a few concepts in the authorization context. A permission becomes a privilege (or right) when it is assigned to someone. So, if you assign permission to access to edit the database, you are granting them that privilege.

- **Audit Tracking**

Audit Tracking helps to track who has scanned what, saved which image and track the users activity in the application and save the details in the cloud as a log for that particular user. It is just simply to track malicious activity and ensure the safety of the users.

# b. Non Functional Requirement:

- **Performance**

The performance of the input device plays the major role in performance of the overall app. The device should have a multicore processor and enough RAM to perform image processing and multiprocessing activities.

- **Compatibility**

Various devices may be used to access the app and if this situation arises, the app should have the required features and enhancements to handle the device variations.

- **Scalability**

The large trained and tested dataset requires scalable platform like IBM Watson for classification and detection purposes. The devices are connected with the cloud which provides scalability, meaning that the hardware requirements will vary based on the input trafic. Use of IBM Watson instructs the use of scalability.

- **Reliability**

The app is used by field scientists who's research will be based on the output provided by the app. Hence reliability of information has to be maintained. The web source from which the information is retrieved should be reliable.

- **Maintainability**

Maintability of the cloud performance, resource and the source code plays a vital role in the accuracy of the app. The existing code of the app has to be maintained and if a

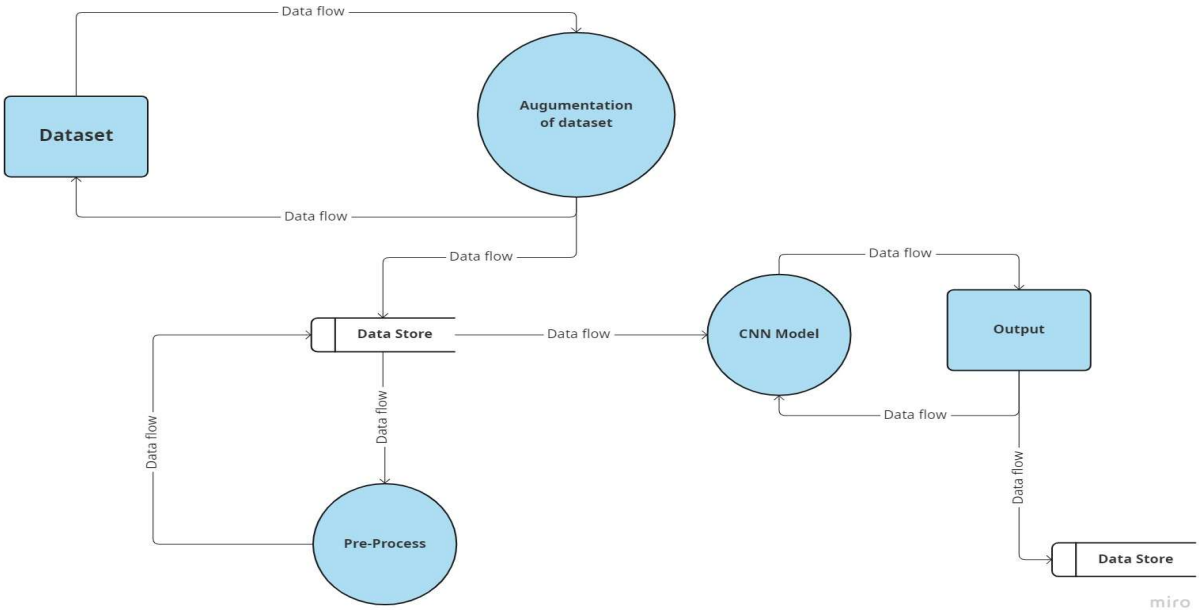
better version or upgraded version is available, the code has to be updated inorder to increase accuracy.

- **Availability**

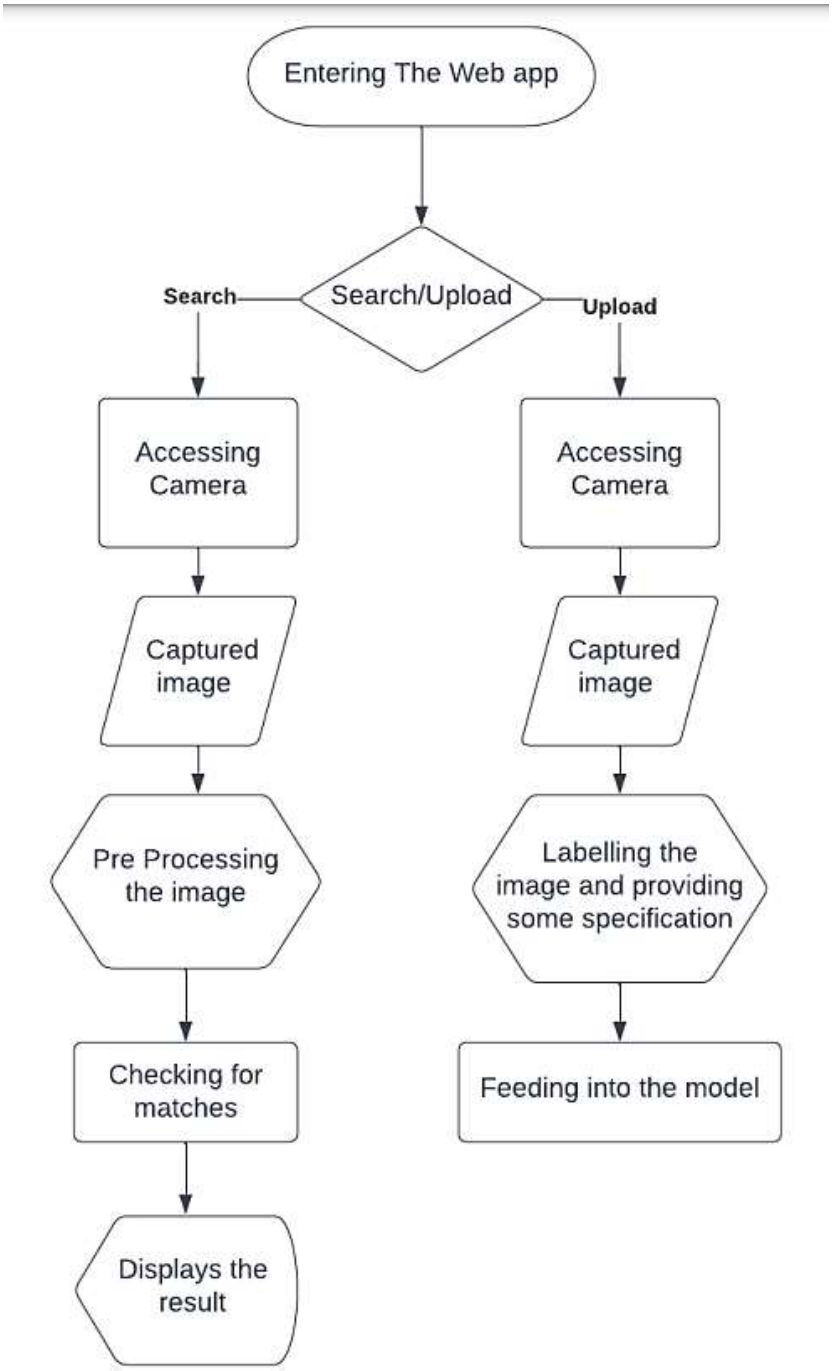
Since cloud is used as the core for the app, the cloud computation service has to be available all the time irrespective of the traffic it faces and load it recieves.

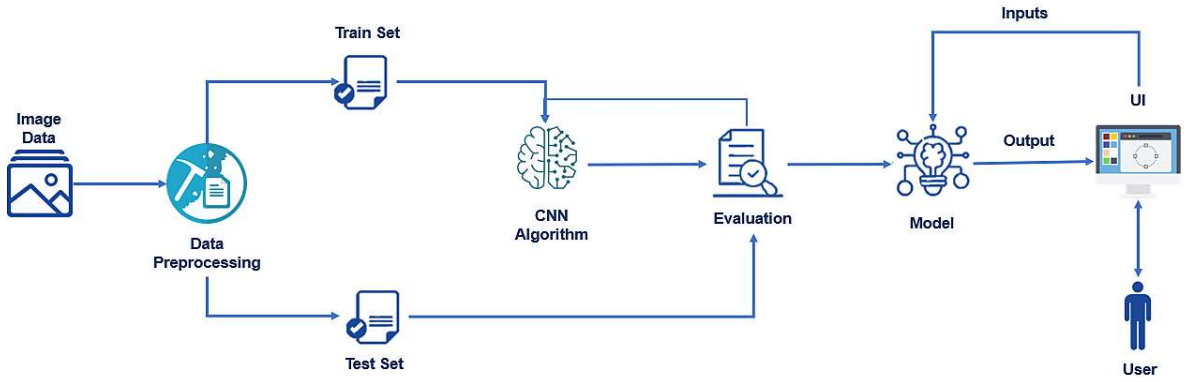
# 5. Project Design

## A. Data Flow Diagrams




## B. Solution & Technical Architecture


Entering The Web app
Search/Upload
Search
Upload
Accessing Camera
Accessing Camera
Captured image
Captured image
Pre Processing the image
Labelling the image and providing some specification
Checking for matches
Feeding into the model
Displays the result




# C. User Stories

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority |
|---|---|---|---|---|---|
| Sprint-1 | Registration | USN-1 | As a user, I can register for the application by Entering my email, and password, and confirming mypassword. | 2 | High |
| Sprint-1 | | USN-2 | As a user, I will receive a confirmation email once I have registered for the application. | 2 | Low |
| Sprint-1 | Login | USN-3 | As a user, I can log into the application by entering myemail & password. | 1 | Medium |
| Sprint-1 | | USN-3 | Effective password verification | 1 | High |
| Sprint-1 | | USN-4 | As a user, I can upload images to identify the species. | 2 | High |
| Sprint-1 | Backend | USN-5 | Datasets are collected to train the model. | 2 | High |
| Sprint-2 | | USN-6 | The data is loaded and Pre-processed to train the model. | 4 | High |
| Sprint-2 | | USN-7 | The model is trained using the Training dataset. | 8 | High |
| Sprint-2 | Optimization | USN-8 | The model is evaluated. | 3 | Medium |
| Sprint-2 | | USN-8 | The model is optimized. | 3 | Medium |
| Sprint-3 | Flask Integration | USN-9 | The application is built using Python Flask. | 8 | High |
| Sprint-3 | | USN-10 | The model is loaded into Python Flask. | 6 | High |
| Sprint-4 | Testing | USN-11 | As a user, I can view the species details. | 3 | Medium |
| Sprint-4 | | USN-11 | As a user, I can view the statistical visualization. | 3 | Medium |
| Sprint-4 | Logout | USN-12 | As a user, I can logout of the application. | 2 | Low |

# 6. Project Design

## A. Sprint Planning & Estimation

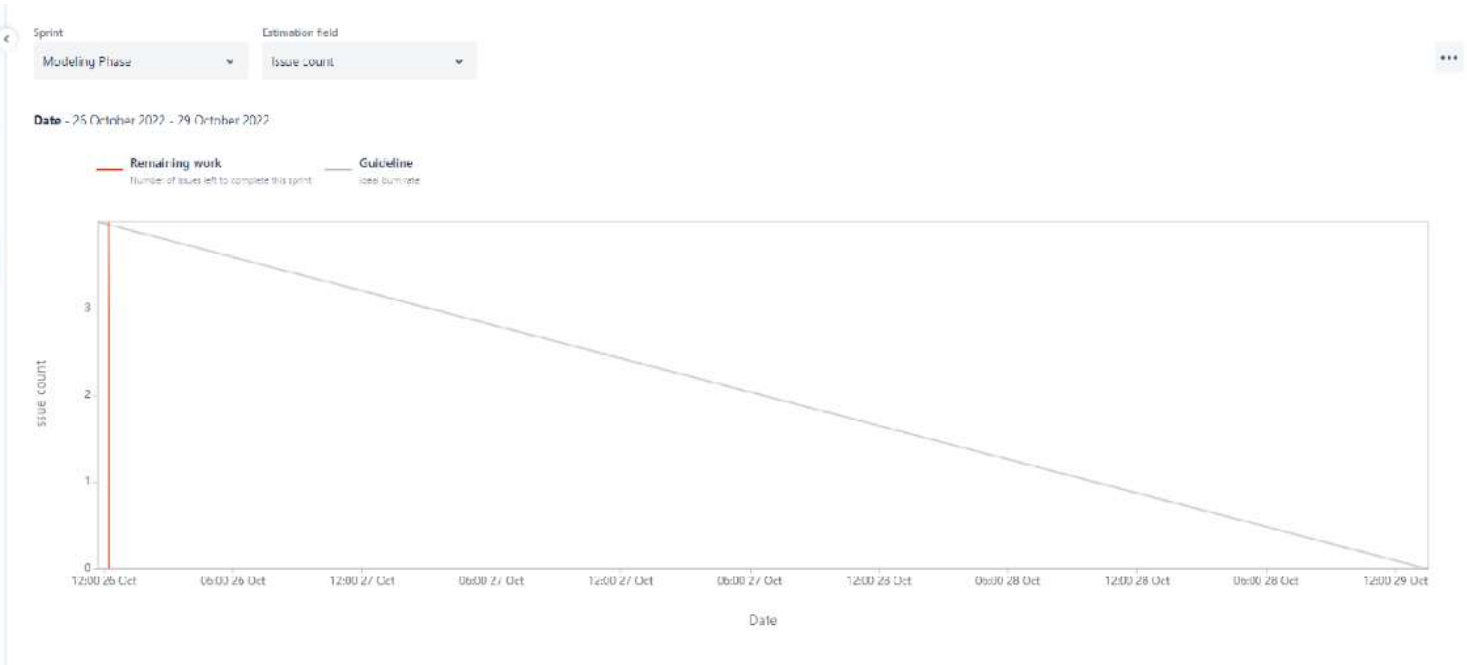
| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|---|---|---|---|---|---|---|
| Sprint-1 | Registration | USN-1 | As a user, I can register for the application by Entering my email, and password, and confirming mypassword. | 2 | High | Ram Shankar B |
| Sprint-1 | | USN-2 | As a user, I will receive a confirmation email once I have registered for the application. | 2 | Low | Pagutharivu |
| Sprint-1 | Login | USN-3 | As a user, I can log into the application by entering myemail & password. | 1 | Medium | Jaikrishna |
| Sprint-1 | | USN-3 | Effective password verification | 1 | High | Venkata Surya Prakash |
| Sprint-1 | | USN-4 | As a user, I can upload images to identify the species. | 2 | High | Pagutharivu |
| Sprint-1 | Backend | USN-5 | Datasets are collected to train the model. | 2 | High | Ram Shankar B |
| Sprint-2 | | USN-6 | The data is loaded and Pre-processed to train the model. | 4 | High | Mukund R S |
| Sprint-2 | | USN-7 | The model is trained using the Training dataset. | 8 | High | Mukund R S |
| Sprint-2 | Optimization | USN-8 | The model is evaluated. | 3 | Medium | Ram Shankar B |
| Sprint-2 | | USN-8 | The model is optimized. | 3 | Medium | Jaikrishna |
| Sprint-3 | Flask Integration | USN-9 | The application is built using Python Flask. | 8 | High | Mukund R S |
| Sprint-3 | | USN-10 | The model is loaded into Python Flask. | 6 | High | Jaikrishna B |
| Sprint-4 | Testing | USN-11 | As a user, I can view the species details. | 3 | Medium | Venkata Surya Prakash |
| Sprint-4 | | USN-11 | As a user, I can view the statistical visualization. | 3 | Medium | Venkata Surya Prakash |
| Sprint-4 | Logout | USN-12 | As a user, I can logout of the application. | 2 | Low | Ram Shankar B |

# B. Sprint Delivery Schedule

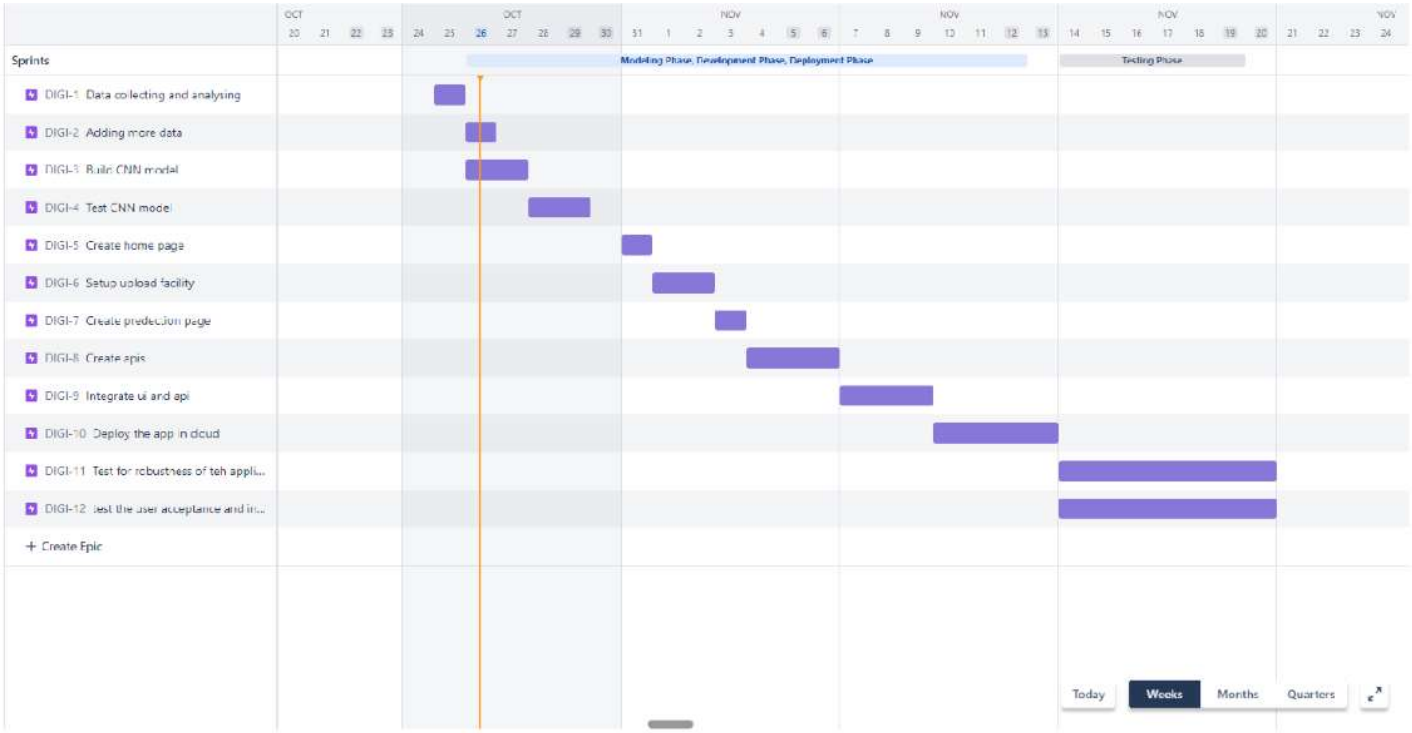
| Sprint | Total Story Points | Duration | Sprint Start Date | Sprint End Date (Planned) | Story Points Completed (as on Planned End Date) | Sprint Release Date (Actual) |
|---|---|---|---|---|---|---|
| Sprint-1 | 10 | 6 Days | 21 Oct 2022 | 26 Oct 2022 | 10 | 26 Oct 2022 |
| Sprint-2 | 18 | 6 Days | 28 Oct 2022 | 02 Nov 2022 | 18 | 02 Nov 2022 |
| Sprint-3 | 14 | 6 Days | 04 Nov 2022 | 09 Nov 2022 | | |
| Sprint-4 | 8 | 6 Days | 11 Nov 2022 | 16 Nov 2022 | | |

# C. Reports from JIRA

## Burn-Out Chart



# Roadmap


OCT
OCT
NOV
NOV
NOV
NOV
Sprints
Modeling Phase, Development Phase, Deployment Phase
Testing Phase
DIGI-1 Data collecting and analysing
DIGI-2 Adding more data
DIGI-3 Build CNN model
DIGI-4 Test CNN model
DIGI-5 Create home page
DIGI-6 Setup upload facility
DIGI-7 Create prediction page
DIGI-8 Create apis
DIGI-9 Integrate ui and api
DIGI-10 Deploy the app in cloud
DIGI-11 Test for robustness of teh appli...
DIGI-12 Test the user acceptance and in...
+ Create Epic
Today
Weeks
Months
Quarters

# 7. Coding and Solutioning

# Feature 1

7.1 **Login and signup pages**

The login page was created. The user can login if he/she already has an account. Otherwise the user has to create new user id and password for login. login.html Login

```
<head>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<meta http-equiv="X-UA-Compatible" content="ie=edge">
<title>Login</title>
<meta name="description" content="">
<meta name="keywords" content="">
<link rel="icon" type="image/x-icon"
href="https://img.icons8.com/fluency/48/000000/natural-food.png">
<link href="https://fonts.googleapis.com/css?family=Source+Sans+Pro:400,700"
rel="stylesheet">
<link rel="stylesheet" href="/static/style.css">
   <style>
      body {
        background-image: url('https://stories.flores.unu.edu/fostering-action-
forbiodiversity/assets/uRBjFJwes9/fallback-1920x1080.jpeg');
        background-repeat: no-repeat;
        background-attachment: fixed;
        background-size: cover;
      }
   </style>
</head>
<body class="leading-normal tracking-normal text-gray-900" style="font-family: 'Source
Sans Pro', sans-serif;">
<div class="h-screen pb-14 bg-right bg-cover">
<!--Nav-->
<div class="w-full container mx-auto p-6">
</div>
<!--Main-->
<div class="container pt-24 md:pt-48 px-6 mx-auto flex flex-wrap flex-colmd:flex-row items-
```

```
center">
<!--Left Col-->
<div class="flex flex-col w-full xl:w-2/5 justify-center lg:items-start
overflow-y-hidden">
<center><h1
class="my-4 text-3xl md:text-5xl text-green-800 fontbold leading-tight text-center md:text-left
slide-in-bottom-h1">
DIGITAL NATURALIST</h1>
<p class="leading-normal text-base md:text-2xl mb-8 textcenter md:text-left slide-in-bottom-
subtitle">
An Artificial Intelligence powered tool for Bio-Diversity
Researchers</p>
        <!--
**********************************************************************************-->
        <section class="ftco-section">
          <div class="container">
            <div class="row justify-content-center">
              <div class="col-md-7 col-lg-5">
                <div class="wrap">
                  <div class="img" style="background-image: url(images/bg1.jpg);"></div>
                  <div class="login-wrap p-4 p-md-5">
                 <div class="d-flex">
                    <div class="w-100">
                      <h3 class="mb-4">SIGN IN</h3>
                    </div>
                 </div>
                      <form action="#" class="signin-form">
                    <div class="form-group mt-3">
                      <input type="text" class="form-control" placeholder="Enter
Username" required>
                      <label class="form-control-placeholder" for="username"
placeholder="Username">
                      </label>
                    </div><div class="form-group">
                   <br>
                  <input id="password-field" type="password" class="form-control"
placeholder="Enter Password" required>
                  <label class="form-control-placeholder" for="password"></label>
                  <span toggle="#password-field" class="fa fa-fw fa-eye field-icon
toggle-password"></span>
                </div>
```

```
                        <div class="form-group">
                          <br>
                        <button type="submit" class="form-control btn btn-primary rounded
submit px-3"><a href="/home">SIGN IN</a></button>
                        </div>
                       </form>
                        <p class="text-center">Not a member? <a data-toggle="tab"
href="/signup.html">Sign Up</a></p>
                      </div>
                     </div>
                      </div>
                    </div>
                  </div>
              </section>
              <!--**********************************************************************-->
</center>
</div>
</div>
</div>
</body>
</html>
signup.html
<!DOCTYPE HTML>
<head>
      <meta charset="UTF-8">
      <meta name="viewport" content="width=device-width, initial-scale=1.0">
      <meta http-equiv="X-UA-Compatible" content="ie=edge"

aded = True,debug=True,port="8000")
```

# Feature 2

App.py and index.html The app trains itself through given set of examples by machine learning and output directs to the wikipedia of particular species. index.html DIGITAL NATURALIST
DIGITAL NATURALIST
An AI powered tool for Bio-Diversity Researchers
Upload a picture and Get species name!!
ResetUpload
app.py

```
from __future__ import division
, print_function
```

```
import os
import numpy as np
import tensorflow as tf
from flask import Flask, redirect, render_template, request
 from keras.applications.inception_v3 import preprocess_input from keras.models import
model_from_json
from werkzeug.utils import secure_filename global graph
graph=tf.compat.v1.get_default_graph()

#this list is used to log the predictions in the server console
predictions = ["Corpse Flower", "Great Indian Bustard", "Lady's slipper orchid", "Pangolin", "Spoon
Billed Sandpiper", "Seneca White Deer" ]

 #this list contains the link to the predicted species

found = [ "https://en.wikipedia.org/wiki/Amorphophallus_titanum",
"https://en.wikipedia.org/wiki/Great_Indian_bustard",
"https://en.wikipedia.org/wiki/Cypripedioideae", "https://en.wikipedia.org/wiki/Pangolin",
"https://en.wikipedia.org/wiki/Spoon-billed_sandpiper",
"https://en.wikipedia.org/wiki/Seneca_white_deer", ] app = Flask(__name__) @app.route('/',
methods=['GET']) def index(): # Home Page return render_template("login.html")
@app.route('/signup', methods=['GET'])
def index1():

# Home Page return render_template("signup.html")
@app.route('/home', methods=['GET'])
def index2():

 # Home Page return render_template("index.html")
@app.route('/predict', methods=['GET', 'POST'])
def upload():
if request.method == 'GET': return ("")
if request.method == 'POST':

 # Fetching the uploaded image from the post request using the id 'uploadedimg'
f = request.files['uploadedimg'] basepath = os.path.dirname(__file__) print(basepath)

#Securing the file by creating a path in local storage
file_path = os.path.join(basepath, 'uploads', secure_filename(f.filename))
print(file_path)
```

```
#Saving the uploaded image locally
f.save(file_path)

#loading the locally saved image
img = tf.keras.utils.load_img(file_path, target_size=(224, 224))

 #converting the loaded image to image array
x = tf.keras.utils.img_to_array(img)
x = preprocess_input(x)

# Converting the preprecessed image to numpy array
inp = np.array([x])
with graph.as_default():

#loading the saved model from training
json_file = open("DigitalNaturalist.json", 'r')
 loaded_model_json = json_file.read()
json_file.close() loaded_model = model_from_json(loaded_model_json)

#adding weights to the trained model
loaded_model.load_weights("DigitalNaturalist.h5")

#predecting the image
preds = np.argmax(loaded_model.predict(inp),axis=1)

#logs are printed to the console
print("Predicted the Species " + str(predictions[preds[0]]))
 text = found[preds[0]]
return redirect(text) if __name__ == '__main__':

#Threads enabled so multiple users can request simultaneously
#debug is turned off, turn on during development to debug the errors
#application is binded to port 8000
app.run(threaded = True,debug=True,port="8000")
```

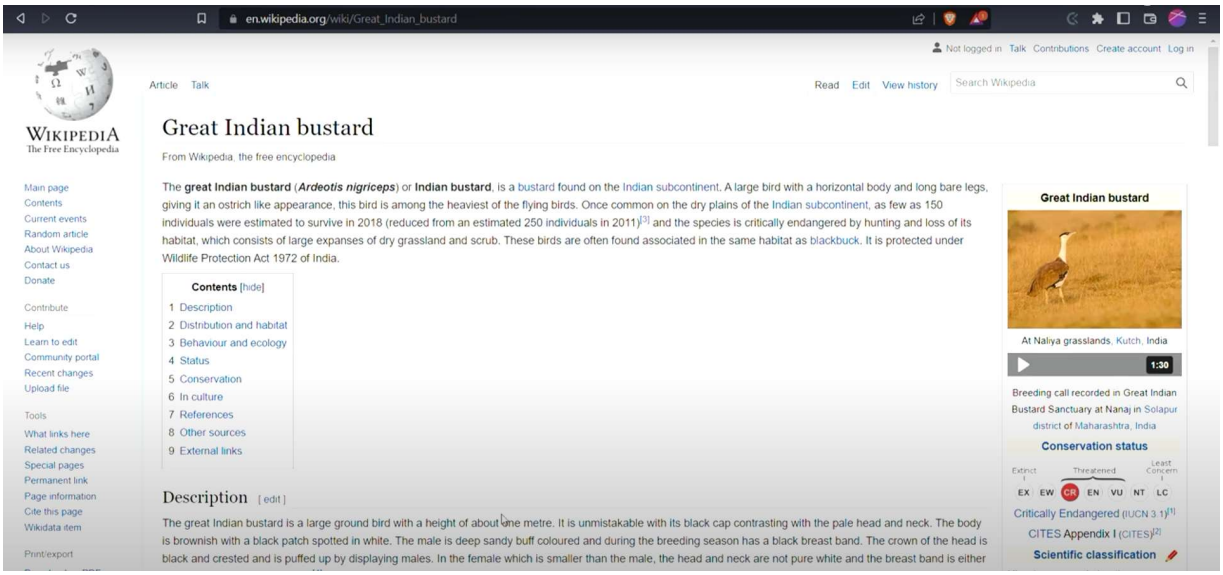
# 8. Testing

The testing is done for

- UI/UX design
- Machine Learning Model
- Flask Integration
- Identification of Species

# Test cases

The input was given as The Great Indian Bustard and the output was verified successfully.

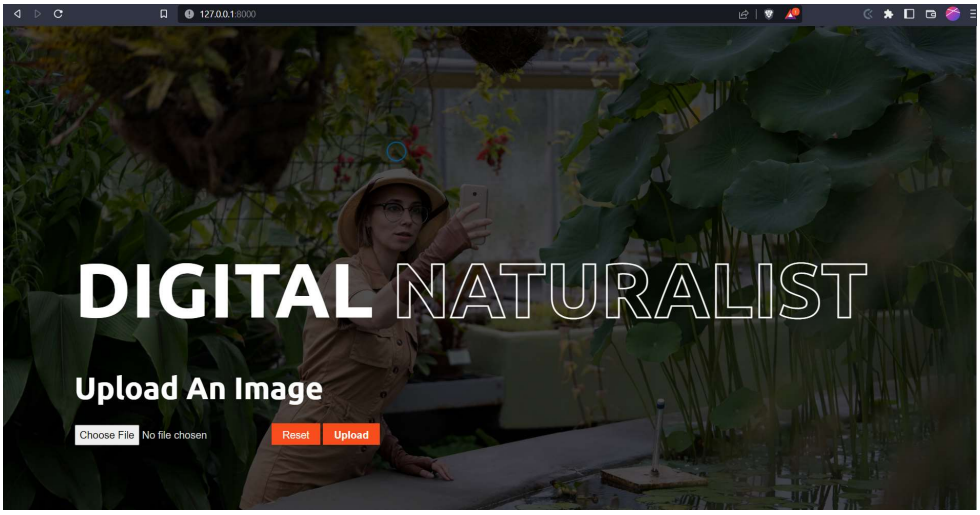


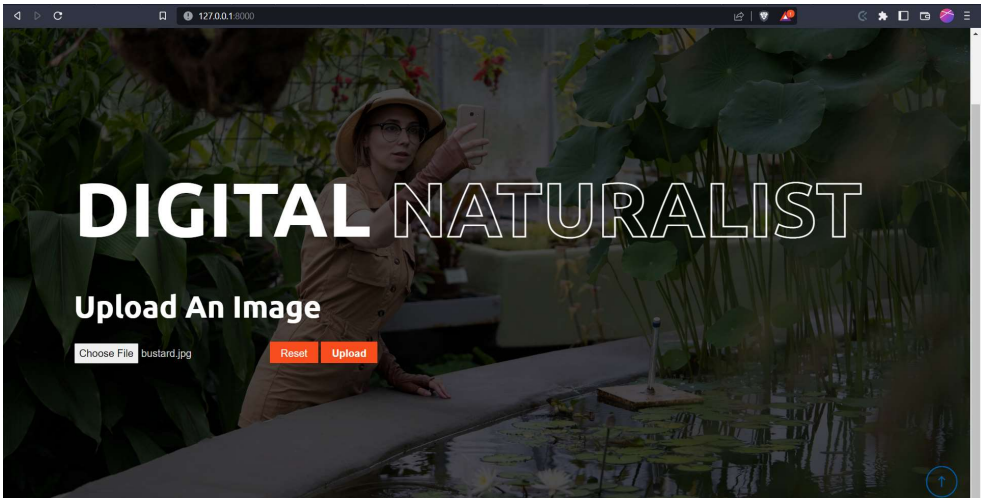

# User acceptance testing

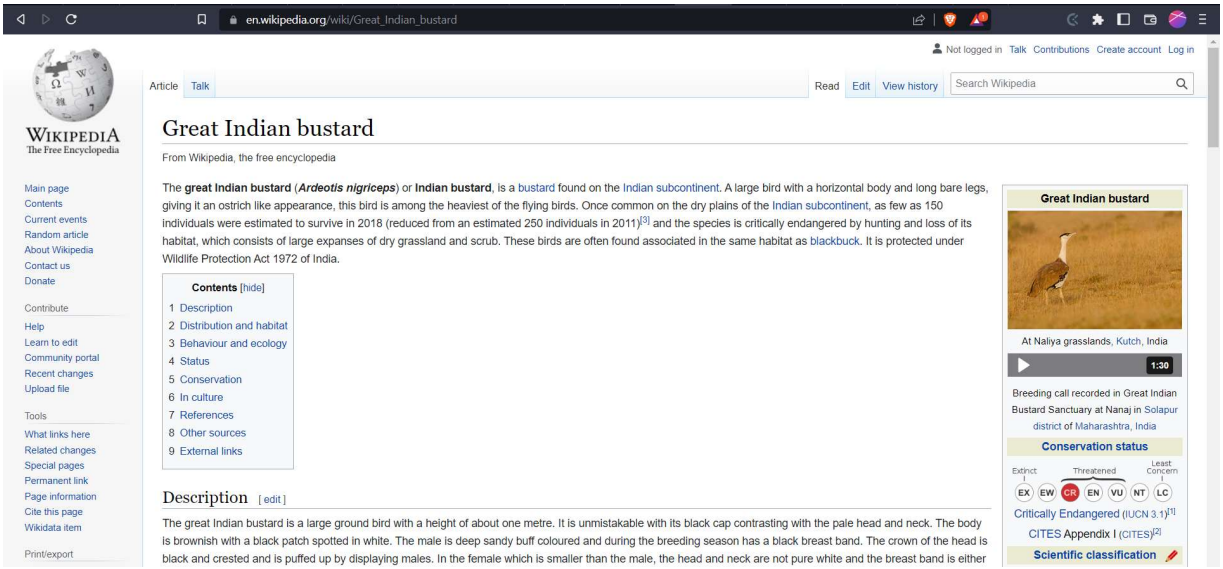
The application runs successfully for given set of inputs. The black box testing is done through unknown person and the output is accurate.

# 9. Results

## a. Performance Metrics






# 10. Advantages and Disadvantages

- Our projects helps many researchers and students to understand more about flora and fauna
- It recognise what type of animals from its foot tracks and plants from its leaves structure
- Researchers can take notes on new behavouir on the spot in software and can analyse it afterwards for research purpose
- It will also display the scientific names of the flora and fauna
- The app requires an internet connectivity to run which can curb the access in remote areas
- The input device requirement is expensive since cameras with decent quality is

required for image classification.

- The app cannot detect species that can camouflage with the environment.

# 11. Conclusion

The app, made with flask and django uses convolutional neural network (CNN) is trained with predefined dataset and the output is displayed and the app is deployed in IBM Cloud. When the field scientist takes a picture of a flora or fauna using their input device, that image is processed against the trained model and the species are identified. The solution is platform independent, meaning that it can be accessed with any device that satisfies the minimum hardware requirement and can be accessed anywhere with just an input device and internet connection. The modularity of the app enables the developer to include additional features in the future such as fossil detection, route analysis and many more.

# 12. Future Scope

- We can update the model to recognise fossils also through this app
- It can show us which species are endagered white their known count
- It will able recognise animals through their sounds
- In future we can devolope this app where we it can show the numbers of endagered species and their count
- It can bring awareness to the users to protect these animals we can also develope this software as such it can recognise the animals from their sounds and displays the users which animal it is
- They can also keep track on the research animals and their behavouir through this app which is helpful to the researchers to analyse their habits