PROJECT DOCUMENTATION

Team ID - PNT2022TMID53094

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

1. **INTRODUCTION**
    1. **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 intend to create 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.

    2. **Purpose**

    The project and hence the tool developed is intended to help naturalists, biologists, ecologists and curious students to identify species that are unknown to them. It will serve as a quick access tool that can help them gain more knowledge and insight on their exploratory pursuits which will aid the scientific community at large in the long run.

2. **LITERATURE SURVEY**
    1. **Existing problem**

Naturalists, archaeologists, researchers and other stakeholders use classification techniques to specify the classes of vast multitude of species they observe. Due to lack of digital applications, stakeholders resort to manual identification and classification of flora and fauna. Lack of internet in forests poses a problem to search every species they identify. This literature review addresses the various ways and classification techniques with which researchers have classified biodiversity with large amounts of datasets collected over a period of time.

2. References

[1] Ghosh S, Kumar H, Nayak JS. Study on Classification of Plants Images using Combined Classifier. International Journal. 2015 Apr;3(4).

[2] Borugadda, P., Lakshmi, R., & Govindu, S. (2021). Classification of Cotton Leaf Diseases Using AlexNet and Machine Learning Models. Current Journal of Applied Science and Technology, 40(38), 29-37. https://doi.org/10.9734/cjast/2021/v40i3831588

[3] Yu Sun, Yuan Liu, Guan Wang, Haiyan Zhang, "Deep Learning for Plant Identification in Natural Environment", Computational Intelligence and Neuroscience, vol. 2017, Article ID 7361042, 6 pages, 2017. https://doi.org/10.1155/2017/7361042

[4] S. G. Wu, F. S. Bao, E. Y. Xu, Y. Wang, Y. Chang and Q. Xiang, "A Leaf Recognition Algorithm for Plant Classification Using Probabilistic Neural Network," 2007 IEEE International Symposium on Signal Processing and Information Technology, 2007, pp. 11-16, doi:10.1109/ISSPIT.2007.4458016.

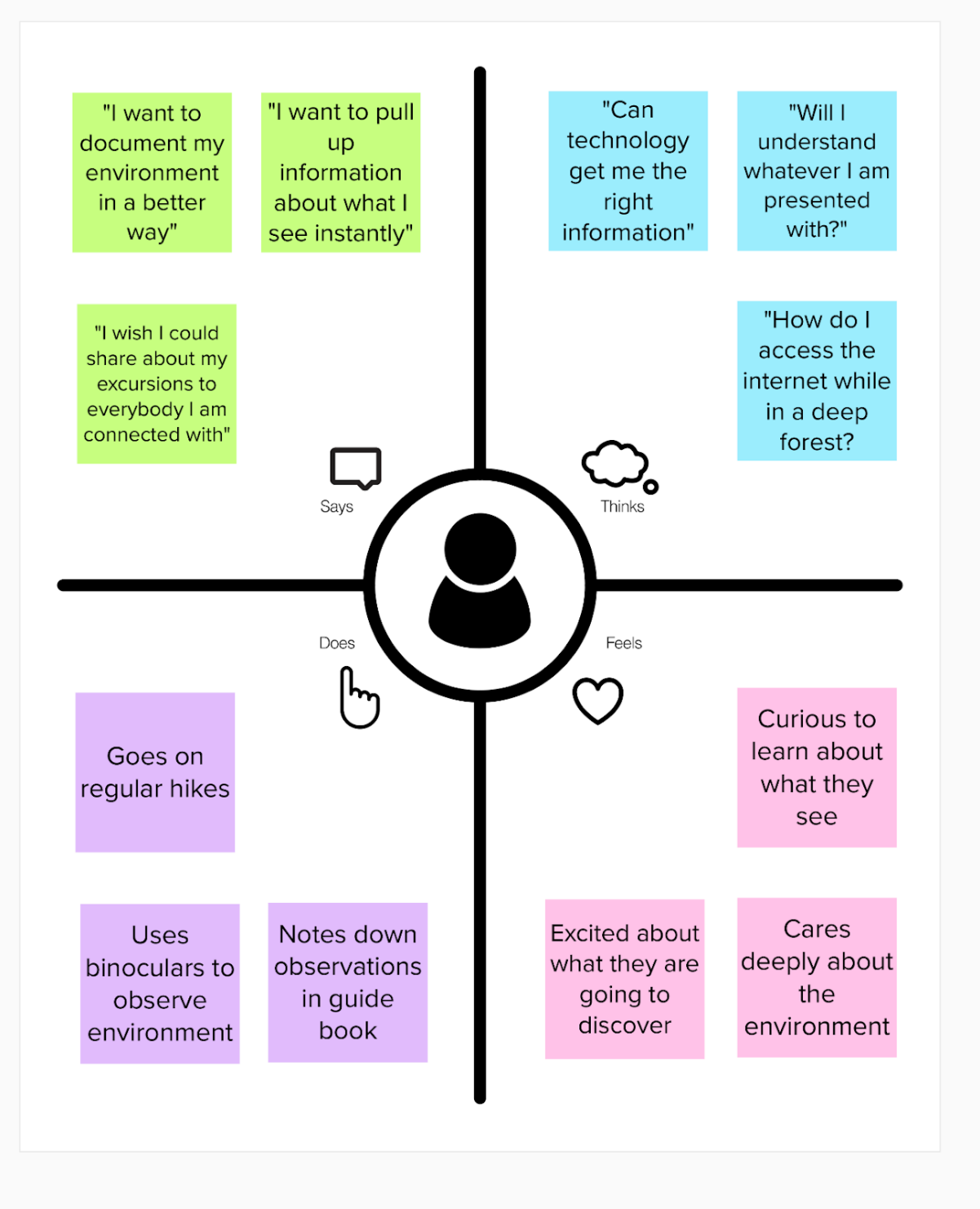
[5] Kumar YS, Manohar N, Chethan HK. Animal classification system: a block-based approach. Procedia Computer Science. 2015 Jan 1;45:336-43

3. Problem Statement Definition

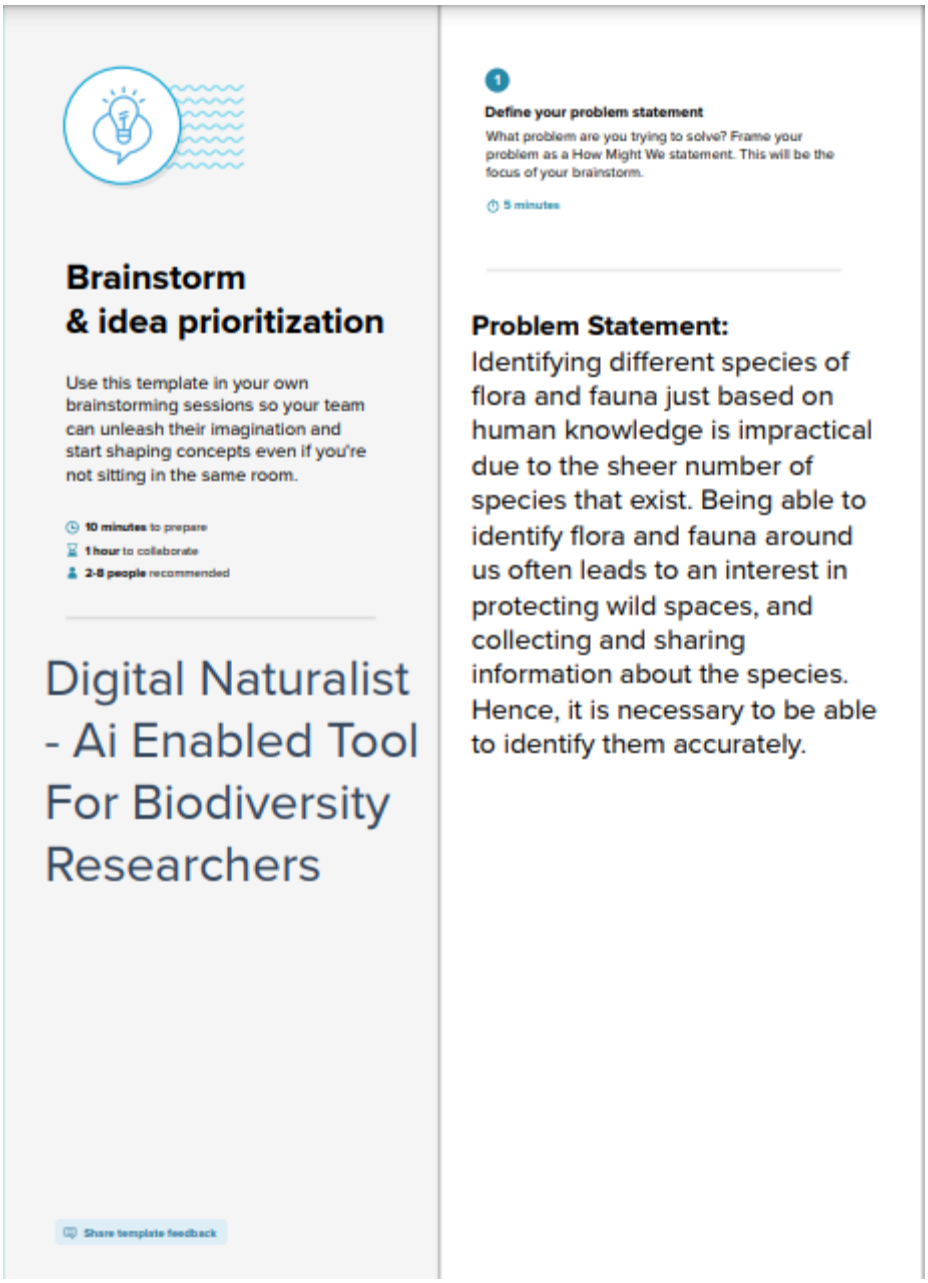
Identifying different species of flora and fauna just based on human knowledge is impractical due to the sheer number of species that exist. Being able to identify flora and fauna around us often leads to an interest in protecting wild spaces, and collecting and sharing information about the species. Hence, it is necessary to be able to identify them accurately.

3. **IDEATION & PROPOSED SOLUTION**

1. **Empathy Map Canvas**



2. **Ideation & Brainstorming**



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

Digital Naturalist - Ai Enabled Tool For Biodiversity Researchers

Share template feedback

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 Statement:
Identifying different species of flora and fauna just based on human knowledge is impractical due to the sheer number of species that exist. Being able to identify flora and fauna around us often leads to an interest in protecting wild spaces, and collecting and sharing information about the species. Hence, it is necessary to be able to identify them accurately.

2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

Nuzair Mohamed

- Interactive app with camera interface
- CNN based ML model for classification
- Usage of batches in training
- Hyperparameter tuning

Pravinkrishnan

- Choice of optimizer and loss function
- Computing model accuracy
- Splitting training and testing
- Web-app and ML model integration

Samyuktha Ganeshkumar

- Data collection
- Image pre-processing
- Accessible UI
- Building a html page

Vaishali C

- One-hot encoding
- Responsive UI
- Real-life implementation
- Data augmentation

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

User-Interface

- Interactive app with camera interface
- Responsive UI
- Accessible UI
- Building a html page

ML Model

- Web-app and ML model integration
- CNN based ML model for classification
- Choice of optimizer and loss function
- Computing model accuracy

Data pre-processing

- Splitting training and testing
- Data augmentation
- Data collection
- Image pre-processing

Model training

- Usage of batches in training
- Hyperparameter tuning
- One-hot encoding
- Real-life implementation

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

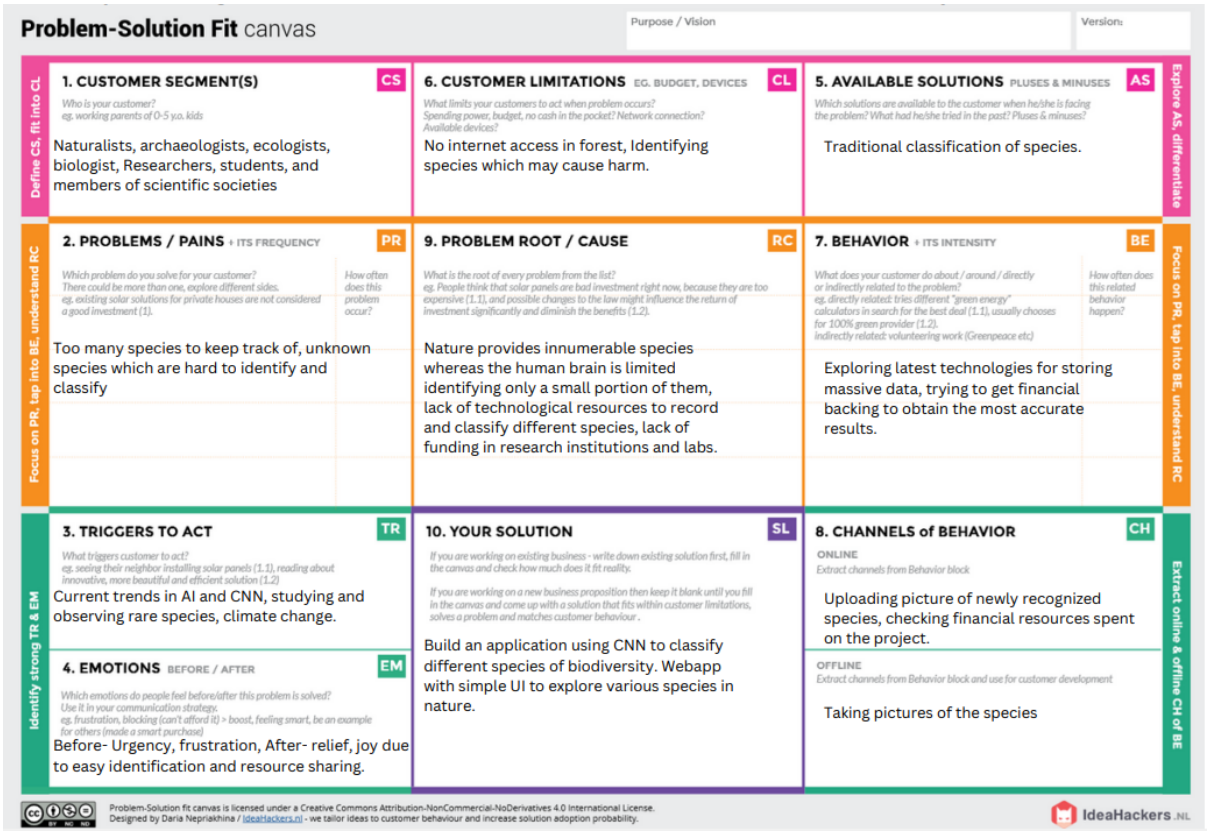
20 minutes

3. **Proposed Solution**

To build a CNN-based model that can classify the different species of birds, mammals and flowers and get the prediction of the species when an image is given. The classification model will be built as a web app with simple UI for easy usability. This application can be used by naturalists and others to explore, identify, and gain easy access to details about the various species present in nature, acting as a guide for digital naturalists.

Solution description	A web application which uses a deep learning model, trained on different species of birds, flowers and mammals and gets the prediction of the species when an image is been given.
Novelty	This solution offers easy access to details about various species of plants and animals acting as a guide for digital naturalists.
Social Impact	The app can be extended to enable naturalists with a community of other naturalists to share their findings and experiences.
Business Model	Field naturalists and conservation organisations will profit, and this could result in income.

4. **Problem Solution fit**



4. **REQUIREMENT ANALYSIS**
    1. **Functional requirements**

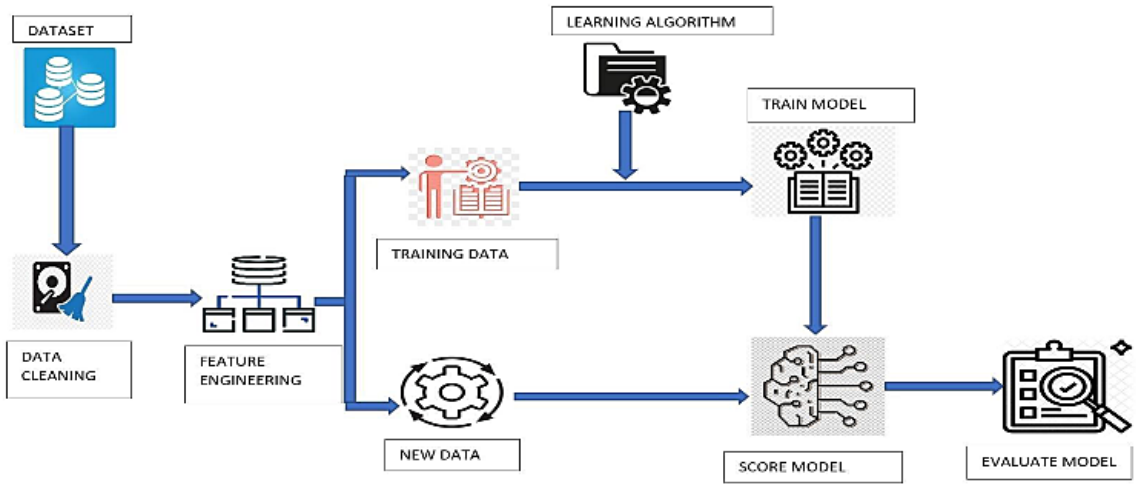
- User input – image input via camera or local file
- Classification output – alert user through prompt with the classified label

    2. **Non-Functional requirements**

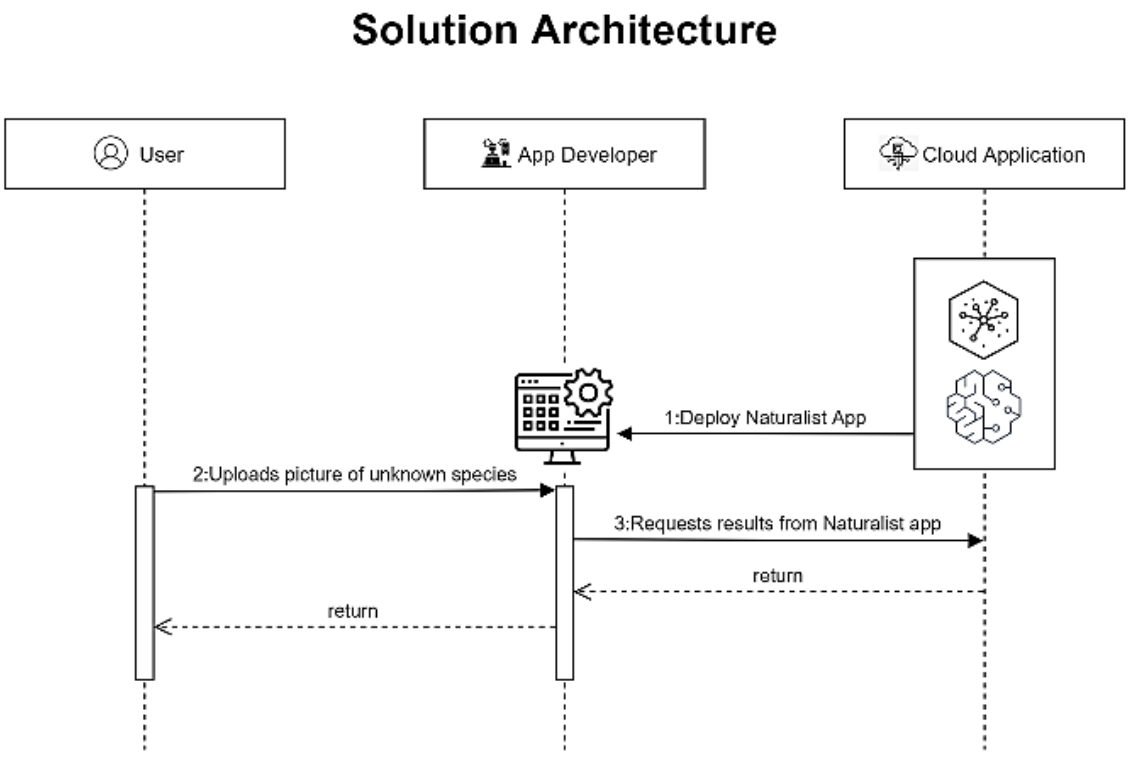
- Usability
- Reliability
- Availability
- Scalability
- Performance

5. **PROJECT DESIGN**

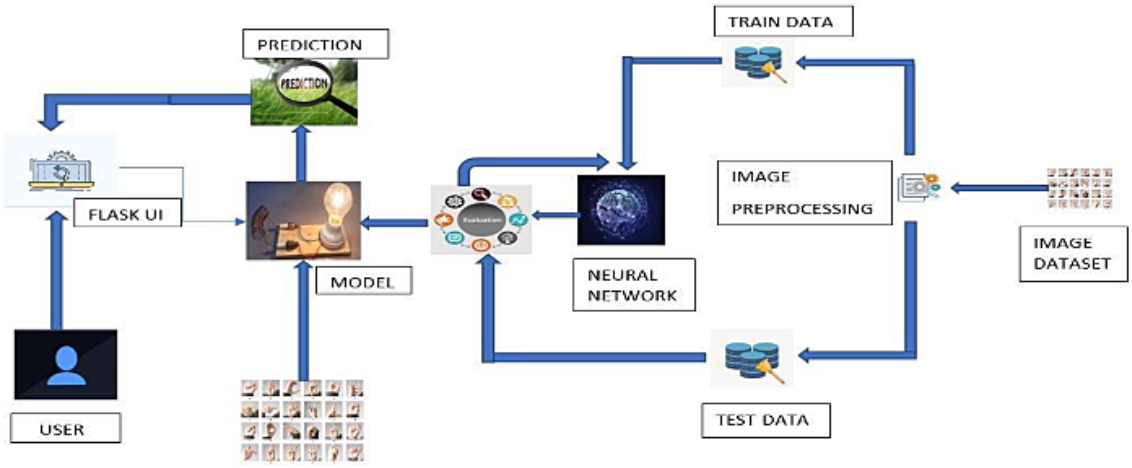
1. **Data Flow Diagrams**



2. **Solution & Technical Architecture**



Technical Architecture:



3. User Stories

Customer Journey

Scenario: Identification of species and engaging with community of digital naturalists	**Entice** How does someone initially become aware of this process?	**Enter** What do people experience as they begin the process?	**Engage** In the core moments in the process, what happens?	**Exit** What do people typically experience as the process finishes?	**Extend** What happens after the experience is over?
Steps What does the person (or group) typically experience?	Visit Website or Download App; Explore Community of digital naturalists; user navigates to species image capture feature; user explores community features	Capturing image; View discussions in community; focus camera on the species they are interested in; learn about other users and their interests	Image uploaded and processing; View results from cloud; Interact with other users; user awaits for results from ML model; user is presented with species they are trying to identify; users post comments	Share identified species; users can post about the species they have identified with the model	Identified species are stored in history; users can keep track of their findings and use them for their research
Interactions What interactions do they have at each step along the way? ▪ **People:** Who do they see or talk to? ▪ **Places:** Where are they? ▪ **Things:** What digital touchpoints or physical objects would they use?	Home Screen of App; Community Page; user is in the environment of interest	Image Capture Page; Discussions section in Community Page	results page; comments and discussions section	Community Page	User Profile and History Page
Goals & motivations At each step, what is a person's primary goal or motivation? ("Help me..." or "Help me avoid...")	Help me learn more about the species I am seeing; Help me interact and learn from other digital naturalists	Help me take a picture of the species; Help me search for and read about ongoing discussions	Help me upload the image successfully and as quick as possible; Help me interact with other users by sharing my comments on their posts	Help me create posts about species I just identified	Help me maintain a history of all my findings to aid my research anytime
Positive moments What steps does a typical person find enjoyable, productive, fun, motivating, delightful, or exciting?	Curiosity and exploration instincts; Build sense of belonging with other digital naturalists	Excitement to learn more about what they are seeing; user feels productive about learning new things	Satisfaction in accomplishing the intended task; Content about helping others and engaging	Proud of having identified species in a new environment	gratification in knowing that they can look back anytime
Negative moments What steps does a typical person find frustrating, confusing, angering, costly, or time-consuming?	confusing emotions about what they app has to offer; information overload	frustration because of unsuccessful attempts in capturing a clear picture; disagreement can cause negative feelings	annoyed with long buffering time	discontent with what they have identified can lead them to not make this decision	
Areas of opportunity How might we make each step better? What ideas do we have? What have others suggested?	How might we deliver the objective of the app intuitively; How might we design the interface to be as simple as possible	How might we inform the user about the image specifications	Uploading and processing should be as efficient as possible for quicker upload time	Cross-platform sharing can increase the outreach	Cross-platform sharing can increase the outreach

User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard.	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application.	I can receive confirmation email & click confirm.	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook.	I can register & access the dashboard with Facebook Login.	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail.	I can register the application using gmail with details linked to the gmail.	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password.	Can enter these credentials either by manual or by auto filling depends on the case.	High	Sprint-1
	Dashboard	USN-6	As a user, I want to know about my data which I have given to see them visually appealing.	Can see the user data after successfully logging onto the application.	Medium	Sprint-1
Customer (Web user)	Registration	USN-7	As a User, I can register for the application through web by entering mobile number / gmail, password and confirming it.	I can access my account / dashboard through web.	High	Sprint-1
Customer Care Executive		USN-8	As a user , I Can get any support if needed by dialing the call or clicking the support.	After completing the registration the user can avail this service.	Medium	Sprint-1
Administrator		USN-9	The company should take care of the admin functionalities.	Admin should have access to each information registered by the user.	High	Sprint-1
Sign Up		USN-10	As a User, I should need to sign up if I don't haven't registered for the account earlier.	The credentials used for signing up should be unique.It is not used by	High	Sprint-1

6. PROJECT PLANNING & SCHEDULING

1. Sprint Planning & Estimation

Product Backlog, Sprint Schedule, and Estimation: (4 Marks)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Modelling Phase	USN-1	Data Acquisition – Collecting and digitalizing data for analysis	3	Medium	Pravin
Sprint-1		USN-2	Data Understanding – Accessing and exploring the data to get useful insights from them	4	High	Samyuktha
Sprint-1		USN-3	Feature engineering – Data Manipulation	2	Medium	Vaishali
Sprint-1		USN-4	Data Augmentation – Increasing the amount of data to avoid overfitting	2	Medium	Nuzair
Sprint-1		USN-5	Model building – Building the model using transfer learning approach	5	High	Samyuktha
Sprint-2		USN-6	Model evaluation and saving - Evaluating the model to check the accuracy and precision	3	High	Vaishali
Sprint-3		USN-7	Database creation for classes	2	Medium	Nuzair
Sprint-2	Development phase	USN-8	User database creation – contains the details of user	1	Low	Pravin
Sprint-2		USN-9	Home page creation – shows features of our application	1	Low	Vaishali
Sprint-2		USN-10	Login and register page creation - Login through email and password, login through Gmail.	1	Low	Nuzair

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2		USN-11	Authentication – OTP verification and SSO	2	Medium	Pravin
Sprint-3		USN-12	Dashboard creation – User profile and features	1	Low	Samyuktha
Sprint-3		USN-13	Setting up facilities for user to feed input	2	Medium	Pravin
Sprint-3		USN-14	Prediction page creation – shows prediction for user input	4	Medium	Vaishali
Sprint-4		USN-15	Model loading - API creation using flask.	5	High	Nuzair
Sprint-4		USN-16	Admin panel creation	4	Medium	Pravin
Sprint-4	Deployment phase	USN-17	Connecting the frontend and backend using API calls	4	Medium	Samyuktha
Sprint-4		USN-18	Cloud deployment – Deployment of application using IBM cloud	5	High	Vaishali
Sprint-4	Testing phase	USN-19	Functional testing – Checking scalability and robustness of the application	5	High	Nuzair
Sprint-4		USN-20	Non-functional testing – Checking for user acceptance and integration	5	High	Samyuktha

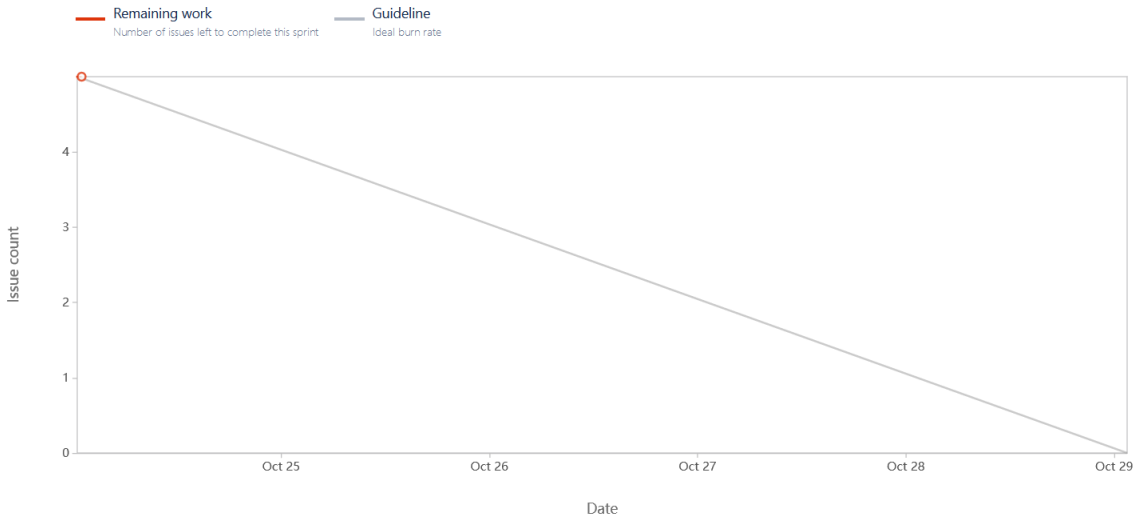
2. Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart: (4 Marks)

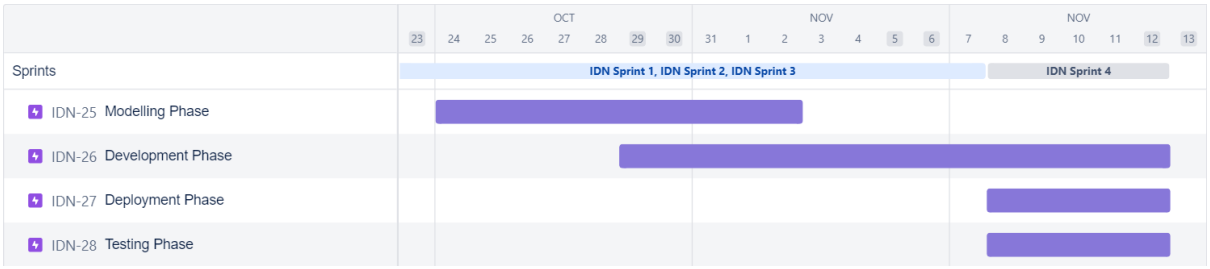
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	16	6 Days	24 Oct 2022	29 Oct 2022		
Sprint-2	8	4 Days	30 Oct 2022	02 Nov 2022		
Sprint-3	13	5 Days	03 Nov 2022	07 Nov 2022		
Sprint-4	24	5 Days	08 Nov 2022	12 Nov 2022		

3. Reports from JIRA

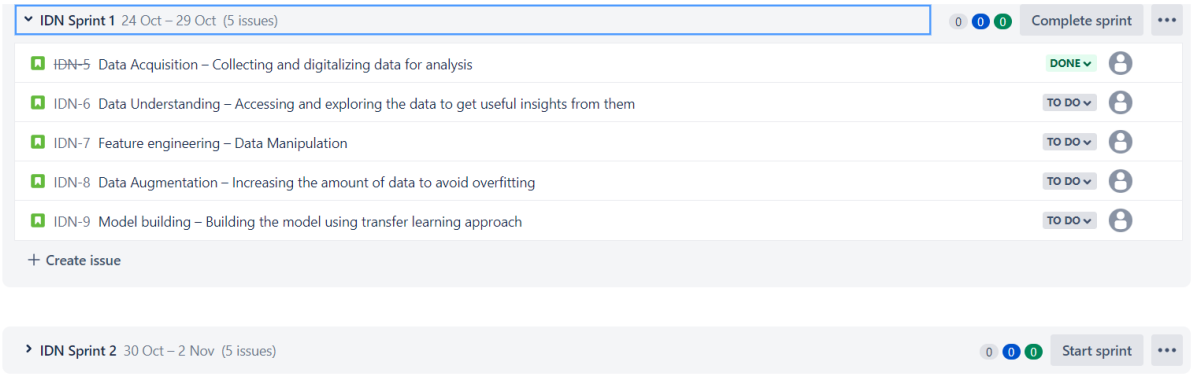
Burndown chart



Roadmap



Dashboard



7. **CODING & SOLUTIONING (Explain the features added in the project along with code)**

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
from tensorflow.keras.utils import load_img,img_to_array
from keras.models import load_model
import json
import secrets
from flask import Flask, flash, render_template, request, redirect, url_for
```

```
ROOT_DIR = os.path.realpath(os.path.join(os.path.dirname(__file__), '..'))
print(ROOT_DIR)

global graph
graph=tf.compat.v1.get_default_graph()


predictions=[
            'Bear Mammal',
 'Bluebell Flower',
 'ColtsFoot Flower',
 'Corpse Flower',
 'Cow Mammal',
 'Daisy Flower',
 'Dandelion Flower',
 'Duck Bird',
 'Eagle Bird',
 'Elephant Mammal',
 'Flamingo Bird',
 'Fox Mammal',
 'Great Indian Bustard Bird',
 'Hornbill Bird',
 'Horse Mammal',
 'Hummingbird Bird',
 'Lady Slipper Orchid Flower',
 'Leopard Mammal',
 'Owl Bird',
 'Panda Mammal',
 'Pangolin Mammal',
 'Parrot Bird',
 'Pigeon Bird',
 'Rat Mammal',
 'Rose Flower',
 'Seneca White Deer Mammal',
 'Spoon Billed Sandpiper Bird',
```

```
 'Sunflower Flower',
 'Tulip Flower',
 'Windflower Flower'
          ]

app = Flask(__name__)


@app.route('/', methods=['GET'])

def index():
   return render_template("index.html")

@app.route('/predict', methods=['GET', 'POST'])

def upload():

   if request.method=='GET':
      return render_template('upload.html')


   if request.method == 'POST':
      f=request.files['image']
      basepath=os.path.dirname(__file__)
      file_path=os.path.join(basepath,'static/uploads',secure_filename(f.filename))
      image_file=os.path.join("static/uploads",secure_filename(f.filename))
      if os.path.isdir(file_path):
          return render_template('upload.html',error="Please upload an image file")
      f.save(file_path)
      img=load_img(file_path,target_size=(229,229))
      x=img_to_array(img)
      x = preprocess_input(x)
      inp = np.array([x])

      with graph.as_default():
         loaded_model=load_model("final_model/final_model.h5")
```

```
        preds =  np.argmax(loaded_model.predict(inp),axis=1)

    text = predictions[preds[0]]



    f = open('predictions.json')


    data = json.load(f)

    description=data[str(preds[0])].get('description')
    species_type=data[str(preds[0])].get('type')

    f.close()


    return
render_template('upload.html',species=text,type=species_type,description=description,
uploaded_image=image_file)



if __name__=='__main__':
   app.run(debug=True)
```

predictions.json


```
{
   "0": {
      "index": "0",
      "type": "Mammal",
      "species ": "Bear",
      "description": "Bears are carnivoran mammals of the family Ursidae. They are
classified as caniforms, or doglike carnivorans. Although only eight species of bears are
extant, they are widespread, appearing in a wide variety of habitats throughout the
Northern Hemisphere and partially in the Southern Hemisphere. Bears are found on the
```

continents of North America, South America, Europe, and Asia. Common characteristics of modern bears include large bodies with stocky legs, long snouts, small rounded ears, shaggy hair, plantigrade paws with five nonretractile claws, and short tails."
},
"1": {
"index": "1",
"type": "Flower",
"species ": "Bluebell",
"description": "Hyacinthoides non-scripta (formerly Endymion non-scriptus or Scilla non-scripta) is a bulbous perennial plant, found in Atlantic areas from north-western Spain to the British Isles, and also frequently used as a garden plant. It is known in English as the common bluebell or simply bluebell, a name which is used in Scotland to refer to the harebell, Campanula rotundifolia. In spring, H. non-scripta produces a nodding, one-sided inflorescence of tubular, sweet-scented violet blue flowers, with strongly recurved tepals, and long, linear, basal leaves."
},
"2": {
"index": "2",
"type": "Flower",
"species ": "ColtsFoot",
"description": "Tussilago farfara, commonly known as coltsfoot, is a plant in the tribe Senecioneae in the family Asteraceae, native to Europe and parts of western and central Asia. The name \"tussilago\" is derived from the Latin tussis, meaning cough, and ago, meaning to cast or to act on. It has had uses in traditional medicine, but the discovery of toxic pyrrolizidine alkaloids in the plant has resulted in liver health concerns"
},
"3": {
"index": "3",
"type": "Flower",
"species ": "Corpse",
"description": "Amorphophallus titanum, the titan arum, is a flowering plant in the family Araceae. It has the largest unbranched inflorescence in the world. The inflorescence of the talipot palm, Corypha umbraculifera, is larger, but it is branched

rather than unbranched. A. titanum is endemic to rainforests on the Indonesian island of Sumatra."
},
"4": {
"index": "4",
"type": "Mammal",
"species ": "Cow",
"description": "Cattle (Bos taurus) are large, domesticated, cloven-hooved, herbivores. They are a prominent modern member of the subfamily Bovinae and the most widespread species of the genus Bos. Adult females are referred to as cows and adult males are referred to as bulls."
},
"5": {
"index": "5",
"type": "Flower",
"species ": "Daisy",
"description": "Bellis perennis, the daisy, is a European species of the family Asteraceae, often considered the archetypal species of the name daisy. To distinguish this species from other plants known as daisies, it is sometimes qualified as common daisy, lawn daisy or English daisy."
},
"6": {
"index": "6",
"type": "Flower",
"species ": "Dandelion",
"description": "Taraxacum is a large genus of flowering plants in the family Asteraceae, which consists of species commonly known as dandelions. The scientific and hobby study of the genus is known as taraxacology. The genus is native to Eurasia and North America, but the two most commonplace species worldwide, T. officinale (the common dandelion) and T. erythrospermum (the red-seeded dandelion), were introduced from Europe into North America, where they now propagate as wildflowers. Both species are edible in their entirety. The common name dandelion is also given to specific members of the genus."
},

```
  "7": {
    "index": "7",
    "type": "Bird",
    "species ": "Duck",
    "description": "Duck is the common name for numerous species of waterfowl in the family Anatidae. Ducks are generally smaller and shorter-necked than swans and geese, which are members of the same family. Divided among several subfamilies, they are a form taxon; they do not represent a monophyletic group (the group of all descendants of a single common ancestral species), since swans and geese are not considered ducks. Ducks are mostly aquatic birds, and may be found in both fresh water and sea water."
  },
  "8": {
    "index": "8",
    "type": "Bird",
    "species ": "Eagle",
    "description": "The Accipitridae is one of the three families within the order Accipitriformes, and is a family of small to large birds with strongly hooked bills and variable morphology based on diet. They feed on a range of prey items from insects to medium-sized mammals, with a number feeding on carrion and a few feeding on fruit. The Accipitridae have a cosmopolitan distribution, being found on all the world's continents (except Antarctica) and a number of oceanic island groups. Some species are migratory."
  },
  "9": {
    "index": "9",
    "type": "Mammal",
    "species ": "Elephant",
    "description": "Elephants are the largest existing land animals. Three living species are currently recognised: the African bush elephant, the African forest elephant, and the Asian elephant. They are the only surviving members of the family Elephantidae and the order Proboscidea. The order was formerly much more diverse during the Pleistocene, but most species became extinct during the Late Pleistocene epoch. Distinctive features of elephants include a long proboscis called a trunk, tusks, large ear flaps, pillar-like legs, and tough but sensitive skin. The trunk is used for breathing, bringing food and water to
```

the mouth, and grasping objects. Tusks, which are derived from the incisor teeth, serve both as weapons and as tools for moving objects and digging. The large ear flaps assist in maintaining a constant body temperature as well as in communication. African elephants have larger ears and concave backs, whereas Asian elephants have smaller ears, and convex or level backs."

},

"10": {

"index": "10",

"type": "Bird",

"species ": "Flamingo",

"description": "Flamingos or flamingoes are a type of wading bird in the family Phoenicopteridae, which is the only extant family in the order Phoenicopteriformes. There are four flamingo species distributed throughout the Americas (including the Caribbean), and two species native to Afro-Eurasia."

},

"11": {

"index": "11",

"type": "Mammal",

"species ": "Fox",

"description": "Foxes are small to medium-sized, omnivorous mammals belonging to several genera of the family Canidae. They have a flattened skull, upright triangular ears, a pointed, slightly upturned snout, and a long bushy tail (or brush)."

},

"12": {

"index": "12",

"type": "Bird",

"species ": "Great Indian Bustard",

"description": "The great Indian bustard (Ardeotis nigriceps) or Indian bustard, is a bustard found on the Indian subcontinent. A large bird with a horizontal body and long bare legs, giving it an ostrich like appearance, this bird is among the heaviest of the flying birds. Once common on the dry plains of the Indian subcontinent, as few as 150 individuals were estimated to survive in 2018 (reduced from an estimated 250 individuals in 2011) and the species is critically endangered by hunting and loss of its habitat, which consists of large expanses of dry grassland and scrub. These birds are

often found associated in the same habitat as blackbuck. It is protected under Wildlife Protection Act 1972 of India."
},
"13": {
"index": "13",
"type": "Bird",
"species ": "Hornbill",
"description": "Hornbills (Bucerotidae) are a family of bird found in tropical and subtropical Africa, Asia and Melanesia. They are characterized by a long, down-curved bill which is frequently brightly coloured and sometimes has a casque on the upper mandible. Both the common English and the scientific name of the family refer to the shape of the bill, \"buceros\" being \"cow horn\" in Greek. Hornbills have a two-lobed kidney. They are the only birds in which the first and second neck vertebrae (the atlas and axis respectively) are fused together; this probably provides a more stable platform for carrying the bill. The family is omnivorous, feeding on fruit and small animals. They are monogamous breeders nesting in natural cavities in trees and sometimes cliffs. A number of mainly insular species of hornbill with small ranges are threatened with extinction, namely in Southeast Asia."
},
"14": {
"index": "14",
"type": "Mammal",
"species ": "Horse",
"description": "The horse (Equus ferus caballus) is a domesticated, one-toed, hoofed mammal. It belongs to the taxonomic family Equidae and is one of two extant subspecies of Equus ferus. The horse has evolved over the past 45 to 55 million years from a small multi-toed creature, Eohippus, into the large, single-toed animal of today. Humans began domesticating horses around 4000 BC, and their domestication is believed to have been widespread by 3000 BC. Horses in the subspecies caballus are domesticated, although some domesticated populations live in the wild as feral horses. These feral populations are not true wild horses, as this term is used to describe horses that have never been domesticated. There is an extensive, specialized vocabulary used to describe equine-related concepts, covering everything from anatomy to life stages, size, colors, markings, breeds, locomotion and behavior."

```
  },
  "15": {
    "index": "15",
    "type": "Bird",
    "species ": "Hummingbird",
    "description": "Hummingbirds are birds native to the Americas and comprise the biological family Trochilidae. With about 361 species and 113 genera, they occur from Alaska to Tierra del Fuego, but the vast majority of the species are found in the tropics around the equator.Hummingbirds split from their sister group, the swifts and treeswifts, around 42 million years ago. The common ancestor of extant hummingbirds is estimated to have lived 22 million years ago in South America. They are known as hummingbirds because of the humming sound created by their beating wings, which flap at high frequencies audible to humans. They hover in mid-air at rapid wing-flapping rates, which vary from around 12 beats per second in the largest species to around 80 per second in small hummingbirds."
  },
  "16": {
    "index": "16",
    "type": "Flower",
    "species ": "Lady Slipper Orchid",
    "description": "Cypripedioideae is a subfamily of orchids commonly known as lady's slipper orchids, lady slipper orchids or slipper orchids. Cypripedioideae includes the genera Cypripedium, Mexipedium, Paphiopedilum, Phragmipedium and Selenipedium. They are characterised by the slipper-shaped pouches (modified labella) of the flowers – the pouch traps insects so they are forced to climb up past the staminode, behind which they collect or deposit pollinia, thus fertilizing the flower. There are approximately 165 species in the subfamily."
  },
  "17": {
    "index": "17",
    "type": "Mammal",
    "species ": "Leopard",
    "description": "The leopard (Panthera pardus) is one of the five extant species in the genus Panthera, a member of the cat family, Felidae. It occurs in a wide range in sub-
```

Saharan Africa, in some parts of Western and Central Asia, Southern Russia, and on the Indian subcontinent to Southeast and East Asia. It is listed as Vulnerable on the IUCN Red List because leopard populations are threatened by habitat loss and fragmentation, and are declining in large parts of the global range. The leopard is considered locally extinct in Hong Kong, Singapore, South Korea, Jordan, Morocco, Togo, the United Arab Emirates, Uzbekistan, Lebanon, Mauritania, Kuwait, Syria, Libya, Tunisia and most likely in North Korea, Gambia, Laos, Lesotho, Tajikistan, Vietnam and Israel. Contemporary records suggest that the leopard occurs in only 25% of its historical global range"
  },
  "18": {
    "index": "18",
    "type": "Bird",
    "species ": "Owl",
    "description": "Owls are birds from the order Strigiformes, which includes over 200 species of mostly solitary and nocturnal birds of prey typified by an upright stance, a large, broad head, binocular vision, binaural hearing, sharp talons, and feathers adapted for silent flight. Exceptions include the diurnal northern hawk-owl and the gregarious burrowing owl."
  },
  "19": {
    "index": "19",
    "type": "Mammal",
    "species ": "Panda",
    "description": "The giant panda (Ailuropoda melanoleuca), also known as the panda bear (or simply the panda), is a bear species endemic to China. It is characterised by its bold black-and-white coat and rotund body. The name \"giant panda\" is sometimes used to distinguish it from the red panda, a neighboring musteloid. Though it belongs to the order Carnivora, the giant panda is a folivore, with bamboo shoots and leaves making up more than 99% of its diet. Giant pandas in the wild occasionally eat other grasses, wild tubers, or even meat in the form of birds, rodents, or carrion. In captivity, they may receive honey, eggs, fish, yams, shrub leaves, oranges, or bananas along with specially prepared food."
  },
  "20": {

"index": "20",
"type": "Mammal",
"species ": "Pangolin",
"description": "Pangolins, sometimes known as scaly anteaters, are mammals of the order Pholidota. The one extant family, the Manidae, has three genera: Manis, Phataginus, and Smutsia. Manis comprises the four species found in Asia, while Phataginus and Smutsia include two species each, all found in sub-Saharan Africa. These species range in size from 30 to 100 cm (12 to 39 in). A number of extinct pangolin species are also known."
},
"21": {
"index": "21",
"type": "Bird",
"species ": "Parrot",
"description": "Parrots, also known as psittacines, are birds of the roughly 398 species in 92 genera comprising the order Psittaciformes, found mostly in tropical and subtropical regions. The order is subdivided into three superfamilies: the Psittacoidea (\"true\" parrots), the Cacatuoidea (cockatoos), and the Strigopoidea (New Zealand parrots). One-third of all parrot species are threatened by extinction, with higher aggregate extinction risk (IUCN Red List Index) than any other comparable bird group. Parrots have a generally pantropical distribution with several species inhabiting temperate regions in the Southern Hemisphere, as well. The greatest diversity of parrots is in South America and Australasia."
},
"22": {
"index": "22",
"type": "Bird",
"species ": "Pigeon",
"description": "The domestic pigeon (Columba livia domestica or Columba livia forma domestica) is a pigeon subspecies that was derived from the rock dove (also called the rock pigeon). The rock pigeon is the world's oldest domesticated bird. Mesopotamian cuneiform tablets mention the domestication of pigeons more than 5,000 years ago, as do Egyptian hieroglyphics. Research suggests that domestication of pigeons occurred as early as 10,000 years ago."

```
  },
  "23": {
    "index": "23",
    "type": "Mammal",
    "species ": "Rat",
    "description": "Rats are various medium-sized, long-tailed rodents. Species of rats are found throughout the order Rodentia, but stereotypical rats are found in the genus Rattus. Other rat genera include Neotoma (pack rats), Bandicota (bandicoot rats) and Dipodomys (kangaroo rats)."
  },
  "24": {
    "index": "24",
    "type": "Flower",
    "species ": "Rose",
    "description": "A rose is either a woody perennial flowering plant of the genus Rosa, in the family Rosaceae, or the flower it bears. There are over three hundred species and tens of thousands of cultivars.They form a group of plants that can be erect shrubs, climbing, or trailing, with stems that are often armed with sharp prickles."
  },
  "25": {
    "index": "25",
    "type": "Mammal",
    "species ": "Seneca White Deer",
    "description": "The Seneca white deer are a rare herd of deer living within the confines of the former Seneca Army Depot in Seneca County, New York. These deer are not albino, but instead have leucism, which is an abnormal genetic condition that carries a set of recessive genes for all-white coats. However, there is still not a lot of evidence as to what caused leucism in the white-tailed deer, especially for this herd. However, researchers have noticed that because of the isolation, it causes high levels of inbreeding. With inbreeding, it leaves recessive alleles of the white-tailed population to be expressed."
  },
  "26": {
    "index": "26",
```

"type": "Bird",
"species ": "Spoon Billed Sandpiper",
"description": "The spoon-billed sandpiper (Calidris pygmaea) is a small wader which breeds on the coasts of the Bering Sea and winters in Southeast Asia. This species is highly threatened, and it is said that since the 1970s the breeding population has decreased significantly. By 2000, the estimated breeding population of the species was 350."
},
"27": {
"index": "27",
"type": "Flower",
"species ": "Sunflower",
"description": "Helianthus is a genus comprising about 70 species of annual and perennial flowering plants in the daisy family Asteraceae commonly known as sunflowers. Except for three South American species, the species of Helianthus are native to North America and Central America. The best-known species is the common sunflower (Helianthus annuus), whose round flower heads in combination with the ligules look like the Sun. This and other species, notably Jerusalem artichoke (H. tuberosus), are cultivated in temperate regions and some tropical regions, as food crops for humans, cattle, and poultry, and as ornamental plants. The species H. annuus typically grows during the summer and into early fall, with the peak growth season being mid-summer."
},
"28": {
"index": "28",
"type": "Flower",
"species ": "Tulip",
"description": "Tulips (Tulipa) are a genus of spring-blooming perennial herbaceous bulbiferous geophytes (having bulbs as storage organs). The flowers are usually large, showy and brightly coloured, generally red, pink, yellow, or white (usually in warm colours). They often have a different coloured blotch at the base of the tepals (petals and sepals, collectively), internally. Because of a degree of variability within the populations, and a long history of cultivation, classification has been complex and controversial. The tulip is a member of the lily family, Liliaceae, along with 14 other

genera, where it is most closely related to Amana, Erythronium and Gagea in the tribe Lilieae."
  },
  "29": {
    "index": "29",
    "type": "Flower",
    "species ": "Windflower",
    "description": "Anemone is a genus of flowering plants in the buttercup family Ranunculaceae. Plants of the genus are commonly called windflowers. They are native to the temperate and subtropical regions of all continents except Australia, New Zealand and Antarctica. The genus is closely related to several other genera including Anemonoides, Anemonastrum, Hepatica, and Pulsatilla. Some botanists include these genera within Anemone"
  }
}

templates:

index.html

```
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="UTF-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Digital Naturalist</title>
  <link rel="stylesheet" href="{{url_for('static',filename='dist/css/output.css')}}">
  <script src="https://unpkg.com/flowbite@1.5.3/dist/flowbite.js"></script>
</head>

<body class="">

  <div class="containir bg-cover min-h-screen w-full flex justify-center items-center"
      style="background-image:
```

url('https://images.pexels.com/photos/1671324/pexels-photo-1671324.jpeg?cs=srgb&dl=pexels-francesco-ungaro-1671324.jpg&fm=jpg&_gl=1*i9kk1o*_ga*MjE1NzQ0MzY2LjE2Njg1MDA5MDE.*_ga_8JE65Q40S6*MTY2ODUwMDkwMS4xLjAuMTY2ODUwMDkwMS4wLjAuMA..');'">

```
<section class=" text-white bg-black p-5 rounded-2xl bg-opacity-30 backdrop-filter backdrop-blur-lg mx-10">
   <div class="grid max-w-screen-xl px-4 py-8 mx-auto lg:gap-8 xl:gap-0 lg:py-16 lg:grid-cols-12">
      <div class="mr-auto place-self-center lg:col-span-7">
         <h1
            class="max-w-2xl mb-6 text-4xl font-extrabold tracking-tight leading-none md:text-5xl xl:text-6xl dark:text-white">
            Digital Naturalist - AI Enabled tool for Biodiversity Researchers</h1>
         <p class="max-w-2xl mb-6 font-light  lg:mb-8 md:text-lg lg:text-xl dark:text-gray-400">
            Are you a nature lover or a bird watcher? There are millions of rare species in the nature. This application helps you
            in identifiying the kind of species and gives you brief information about it. This application uses neural networks
            which can identify some of the rare bird and animal species.
          </p>
         <a href="/predict"
            class="inline-flex items-center justify-center px-5 py-3 mr-3 text-base font-medium text-center text-white rounded-lg bg-primary-700 hover:bg-primary-800 focus:ring-4 focus:ring-primary-300 dark:focus:ring-primary-900">
            Get started
            <svg class="w-5 h-5 ml-2 -mr-1" fill="currentColor" viewBox="0 0 20 20"
               xmlns="http://www.w3.org/2000/svg">
               <path fill-rule="evenodd"
                  d="M10.293 3.293a1 1 0 011.414 0l6 6a1 1 0 010 1.414l-6 6a1 1 0 01-1.414-1.414L14.586 11H3a1 1 0 110-2h11.586l-4.293-4.293a1 1 0 010-1.414z"
```

```
                clip-rule="evenodd"></path>
            </svg>
          </a>

      </div>
      <div class="hidden lg:mt-0 lg:col-span-5 lg:flex">
        <img src="https://images.unsplash.com/photo-1486365227551-
f3f90034a57c?ixlib=rb-
4.0.3&ixid=MnwxMjA3fDB8MHxwaG90by1wYWdlfHx8fGVufDB8fHx8&auto=for
mat&fit=crop&w=2340&q=80" alt="mockup">
      </div>
  </div>
</section>



  </div>



</body>

</html>
```

upload.html

```
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="UTF-8">
  <meta http-equiv="X-UA-Compatible" content="IE=edge">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Digital Naturalist</title>
  <link rel="stylesheet" href="{{url_for('static',filename='dist/css/output.css')}}">
  <script src="https://unpkg.com/flowbite@1.5.3/dist/flowbite.js"></script>
```

```
</head>

<body class="">

   <div class="containir bg-cover min-h-screen w-full flex justify-center items-center"
      style="background-image: url('https://images.pexels.com/photos/1671324/pexels-photo-1671324.jpeg?cs=srgb&dl=pexels-francesco-ungaro-1671324.jpg&fm=jpg&_gl=1*i9kk1o*_ga*MjE1NzQ0MzY2LjE2Njg1MDA5MDE.*_ga_8JE65Q40S6*MTY2ODUwMDkwMS4xLjAuMTY2ODUwMDkwMS4wLjAuMA..');'">



<section class=" text-white bg-black p-5 rounded-2xl bg-opacity-30 backdrop-filter backdrop-blur-lg mx-10">
      <a href="/"> <svg class="w-6 h-6 " fill="none" stroke="currentColor" viewBox="0 0 24 24"
            xmlns="http://www.w3.org/2000/svg">
            <path stroke-linecap="round" stroke-linejoin="round" stroke-width="2" d="M10 19l-7-7m0 0l7-7m-7 7h18"></path>
         </svg>
      </a>
   <div class="grid max-w-screen-xl px-4 py-8 mx-auto lg:gap-8 xl:gap-0 lg:py-16 lg:grid-cols-12">
      <div class="mr-auto place-self-center lg:col-span-7">

         <h1
            class=" max-w-2xl mb-4 text-4xl font-extrabold tracking-tight leading-none md:text-5xl xl:text-6xl dark:text-white">
            Digital Naturalist</h1>
         <p class="max-w-2xl mb-6 font-light  lg:mb-8 md:text-lg lg:text-xl dark:text-gray-400">
           Upload any image from your device or click a picture of the flora or
```

```
fauna you want to know more about right here!
            </p>


      </div>

   </div>

<form method="post" action="/predict" enctype="multipart/form-data">

<div class="lg:flex ">
<div class=" lg:flex flex-col px-4  lg:w-1/3  ">


<label class="font-medium mb-2 text-white" for="file_input">Upload
Image</label>
<input
   class=" w-full text-sm text-gray-900 rounded-lg cursor-pointer bg-gray-50
focus:outline-none "
   aria-describedby="file_input_help" id="file_input" type="file" name="image">
<p class="mt-2 text-sm " id="file_input_help">SVG, PNG, JPG</p>


   <!-- <button
      class=" w-full text-white bg-gray-500 hover:bg-gray-800 focus:ring-4
focus:ring-blue-300 font-medium rounded-lg text-sm px-5 py-5 my-5
focus:outline-none ">
      <span class="flex items-center justify-center">
      <svg class="w-6 h-6" fill="none" stroke="currentColor" viewBox="0 0 24 24"
xmlns="http://www.w3.org/2000/svg">
         <path stroke-linecap="round" stroke-linejoin="round" stroke-width="2"
            d="M3 9a2 2 0 012-2h.93a2 2 0 001.664-.89l.812-1.22A2 2 0 0110.07
4h3.86a2 2 0 011.664.89l.812 1.22A2 2 0 0018.07 7H19a2 2 0 012 2v9a2 2 0 01-2
2H5a2 2 0 01-2-2V9z">
         </path>
```

```
        <path stroke-linecap="round" stroke-linejoin="round" stroke-width="2"
d="M15 13a3 3 0 11-6 0 3 3 0 016 0z"></path>
      </svg>
        <span class="px-5">Capture Image</span>
<input type="file" accept="image/*;capture=camera" class="hidden" >
</button> -->

<button
type="submit"
  class=" w-full text-white bg-gray-500 hover:bg-gray-800 focus:ring-4 focus:ring-
blue-300 font-medium rounded-lg text-sm px-5 py-5 my-5  focus:outline-none
">Predict Specimen</button>
</div>

<div class="lg:flex flex-col mx-auto p-5 break-words ">

  <p >{{error}}</p>


  {% if uploaded_image  is defined %}
  <img src="{{ uploaded_image }}" class="w-full h-full">
  {% endif %}

    {% if species is defined %}
  <p class="text-2xl font-medium p-5" >

  {{ species }}
</p>
<p class="text-2xl  p-5" >

  {{type}}
</p>
<p class="text-2xl p-5" >

  {{description}}
```

```
</p>
    {% endif %}

    <div class="flex space-x-2">
      <a href="https://twitter.com/intent/tweet?text=I just discovered
{{species}} on my hike! Loving Digital Naturalist app!" target="_blank">
        <svg width="40" height="34" viewBox="0 0 40 34" fill="none"
xmlns="http://www.w3.org/2000/svg">
          <path d="M35.9049 8.84015C35.9293 9.19278 35.9293 9.54541
35.9293 9.90129C35.9293 20.7451 27.6742 33.2513 12.5793
33.2513V33.2448C8.12025 33.2513 3.75381 31.974 0 29.5657C0.648385
29.6437 1.30002 29.6827 1.95328 29.6843C5.64859 29.6876 9.23827 28.4477
12.1454 26.1645C8.63376 26.0979 5.55434 23.8083 4.47857 20.4656C5.70871
20.7028 6.97623 20.6541 8.18363 20.3242C4.35507 19.5507 1.60065 16.1869
1.60065 12.2803C1.60065 12.2446 1.60065 12.2104 1.60065 12.1763C2.74142
12.8117 4.01869 13.1643 5.32521 13.2033C1.71928 10.7934 0.607759 5.99635
2.78529 2.24579C6.95186 7.37275 13.0993 10.4895 19.6986 10.8194C19.0372
7.96913 19.9407 4.98234 22.0727 2.97868C25.378 -0.128369 30.5765
0.0308836 33.6835 3.33456C35.5214 2.97218 37.283 2.29779 38.895
1.34228C38.2823 3.24193 37.0002 4.85558 35.2874 5.88097C36.9141 5.68922
38.5034 5.25371 40 4.58908C38.8982 6.2401 37.5105 7.67825 35.9049
8.84015Z" fill="white"/>
        </svg>


      </a>


      <a href="whatsapp://send?text=I just discovered {{species}} on my hike!
Loving Digital Naturalist app!"      data-action="share/whatsapp/share"
      target="_blank">


      <svg width="36" height="36" viewBox="0 0 36 36" fill="none"
```

xmlns="http://www.w3.org/2000/svg">
<path d="M18.0755 0.580627C8.19522 0.580627 0.154452 8.32527
0.150968 17.8432C0.148645 20.887 0.975484 23.8575 2.54323 26.4739L0
35.4193L9.50284 33.019C12.1462 34.4017 15.0854 35.1229 18.0685
35.1209H18.0755C27.9557 35.1209 35.9965 27.3751 36 17.8571C36.0023
13.2468 34.1396 8.90708 30.7545 5.64501C27.3705 2.38179 22.8705 0.581789
18.0755 0.580627ZM18.0755 32.2049H18.0697C15.3964 32.2049 12.7742
31.5128 10.4865 30.2051L9.94065 29.8939L4.30374 31.3177L5.80877
26.0222L5.45458 25.4799C3.96686 23.2109 3.17489 20.5564 3.17613
17.8432C3.17961 9.93134 9.864 3.49663 18.0813 3.49663C22.0599 3.49779
25.8004 4.99237 28.6142 7.70398C31.428 10.4156 32.976 14.0214 32.9737
17.856C32.9702 25.7679 26.287 32.2049 18.0743 32.2049H18.0755ZM26.2475
21.4571C25.7992 21.2423 23.5974 20.1983 23.1863 20.0531C22.7764 19.9103
22.4779 19.836 22.1795 20.268C21.8822 20.7 21.0228 21.672 20.7627
21.9588C20.5003 22.2468 20.239 22.2817 19.7907 22.0668C19.3425 21.8508
17.899 21.3956 16.1895 19.9254C14.8575 18.7827 13.9587 17.3706 13.6974
16.9374C13.4361 16.5066 13.6695 16.2731 13.8937 16.0583C14.0946 15.8667
14.3419 15.5555 14.5649 15.3035C14.7879 15.0515 14.8622 14.8715 15.0132
14.5835C15.1618 14.2966 15.0875 14.0435 14.9748 13.8286C14.8622 13.6115
13.968 11.4886 13.5929 10.6258C13.2306 9.78501 12.8613 9.89766 12.5861
9.88372C12.3248 9.87211 12.0275 9.86863 11.7267 9.86863C11.4306 9.86863
10.944 9.97663 10.5329 10.4086C10.123 10.8406 8.96516 11.8835 8.96516
14.0063C8.96516 16.1303 10.5701 18.1811 10.7942 18.4691C11.0183 18.756
13.9529 23.1143 18.4459 24.984C19.5143 25.4264 20.3481 25.6924 20.9996
25.8921C22.0726 26.2208 23.0493 26.1731 23.8204 26.0628C24.6797 25.9386
26.4705 25.02 26.8421 24.0131C27.216 23.0063 27.216 22.1423 27.1045
21.9623C26.9954 21.7823 26.6957 21.6743 26.2475 21.4571V21.4571Z"
fill="white"/>
</svg>


```
</div>
</div>


</form>


</section>

</div>



</body>

</html>
```

1. **Feature 1**

The application takes pictures as input and classifies them according to their type (mammals, birds, flowers). The model has been trained on 30 different species of different types with 5000 images. It is a responsive application and can be used for both desktop and mobile users. Since the stakeholders are mainly researchers who need to classify plant or animal photos taken in their cameras, this app is aimed for mobile phones users

2. **Feature 2**

The application has been extended to whatsapp and twitter where pictures from whatsapp can be uploaded to the webpage and classified.

3. **Database Schema (if Applicable)**

```
id: {
      "index": " ",
      "type": " ",
      "species ": " ",
      "description": " "
   }
```

8. TESTING

1. Test Cases

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	Executed By
Pred_test01	Functional	CNN model	Check if the CNN model performs correct prediction	Image input, Loaded model	Run the IBMDN.py file and provide image path as input	Flora and Fauna species from the trained data	Correct Species name	Correct Species name	Pass	Working as expected	Pravin,Nuzair
UI_test01	Functional	Web Application	Check if the Web app model produces the same correct prediction as model	Image input	Run the flask app(local)	Flora and Fauna species from the trained data	Correct Species name	Correct Species name	Pass	Working as expected	Samyuktha,Vaishali
UI_test02	Functional	Web Application	Check if the Web app model produces the same correct prediction as model	Image input	Click on deployment URL	Flora and Fauna species from the trained data	Correct Species name	Correct Species name	Pass	Working as expected	Pravin,Nuzair
Sharefeature01	Non functional	Web Application	Check if the user can share the prediction result on whatsapp	Prediction output	Click on the whatsapp icon after receiving prediction result	Prediction image and result	Able to share successfully	Able to share successfully	Pass	Working as expected	Samyuktha,Vaishali
Sharefeature02	Non functional	Web Application	Check if the user can share the prediction result on twitter	Prediction output	Click on the twitter icon after receiving prediction result	Prediction image and result	Able to share successfully	Able to share successfully	Pass	Working as expected	Pravin,Samyuktha

2. User Acceptance Testing

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Digital Naturalist project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	4	0	0	0	4
Duplicate	0	0	0	0	0
External	0	1	0	1	2
Fixed	8	0	3	0	11
Not Reproduced	0	0	1	0	1
Skipped	1	0	0	0	1
Won't Fix	0	1	1	1	3
Totals	13	2	5	2	22

3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

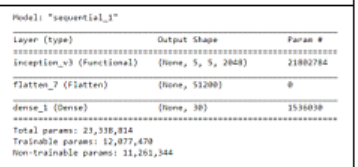
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	2	0	0	2
Client Application	30	0	0	30
Outsource Shipping	3	0	0	3
Exception Reporting	1	0	0	1
Final Report Output	31	0	0	31
Version Control	2	0	0	2

9. **RESULTS**

1. **Performance Metrics**

Model Performance Testing:

Project team shall fill the following information in model performance testing template.

<table>
<tr><th>S.No.</th><th>Parameter</th><th>Values</th><th>Screenshot</th></tr>
<tr><td>1.</td><td>Model Summary</td><td>Model: "sequential_1"
<table>
<tr><th>Layer (type)</th><th>Output Shape</th><th>Param #</th></tr>
<tr><td>inception_v3 (Functional)</td><td>(None, 5, 5, 2048)</td><td>21802784</td></tr>
<tr><td>flatten_7 (Flatten)</td><td>(None, 51200)</td><td>0</td></tr>
<tr><td>dense_1 (Dense)</td><td>(None, 30)</td><td>1536030</td></tr>
</table></td><td> 
</td></tr>
<tr><td>2.</td><td>Accuracy</td><td>Training Accuracy - 98.46 %

Validation Accuracy -86.94 %</td><td>The accuracy of the model:98.46 %
The accuracy of the testing:86.94 %</td></tr>
</table>

10. **ADVANTAGES & DISADVANTAGES**

Advantages

This project is scalable, since the model can achieve more accurate results by training it with a larger data set which can be used in real time. It can be extended for various other applications such as human classification and user profiling. This app is useful for both mobile phone and desktop users. It is also useful for social media users and easy access to images.

Disadvantages

Inaccurate classification of images sometimes due to smaller dataset. It runs slowly and can be improved for faster results. The dataset used is limited in classes and species due to which rare species may not be identified correctly. The descriptions for all the species are taken from wikipedia and may contain misinformation. Proper references and names can be taken from formal research resources.

11. CONCLUSION

The digital naturalist AI enabled tool has been used for classification of flora and fauna for biodiversity researchers .This can be used as a quick access application that can be used on the go for instantaneous classification and knowledge acquiring and will prove to be a highly useful tool for the intended users like naturalists, biologists, and curious students.

12. FUTURE SCOPE

The application can be further extended by linking it to an animal and plant species database and enhancing the model to predict all existing recorded species. The sharing feature can further be extended to all apps and platforms. The method of taking input can be improvised by making it a live feed video based input.

13. APPENDIX

GitHub & Project Demo Link

https://github.com/IBM-EPBL/IBM-Project-16164-1659608637

Project Demo link

https://drive.google.com/file/d/12pv2Nc3HmaCuBxOidBCKsrCsMNrXkmQc/view?usp=drivesdk