IBM-Project-4741-1658738702

TEAM ID : PNT2022TMID49396

TEAM LEADER   **- YAZHINI S**
TEAM MEMBER 1 - SWETHA V
TEAM MEMBER 2 - AMETHYST SARDONYX P
TEAM MEMBER 3 - RAJAM JENIFER N
TEAM MEMBER 4 - RAMYA S

Digital Naturalist - AI Enabled tool for Biodiversity Researchers

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.

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.

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.

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.

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)

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.

Empathy map
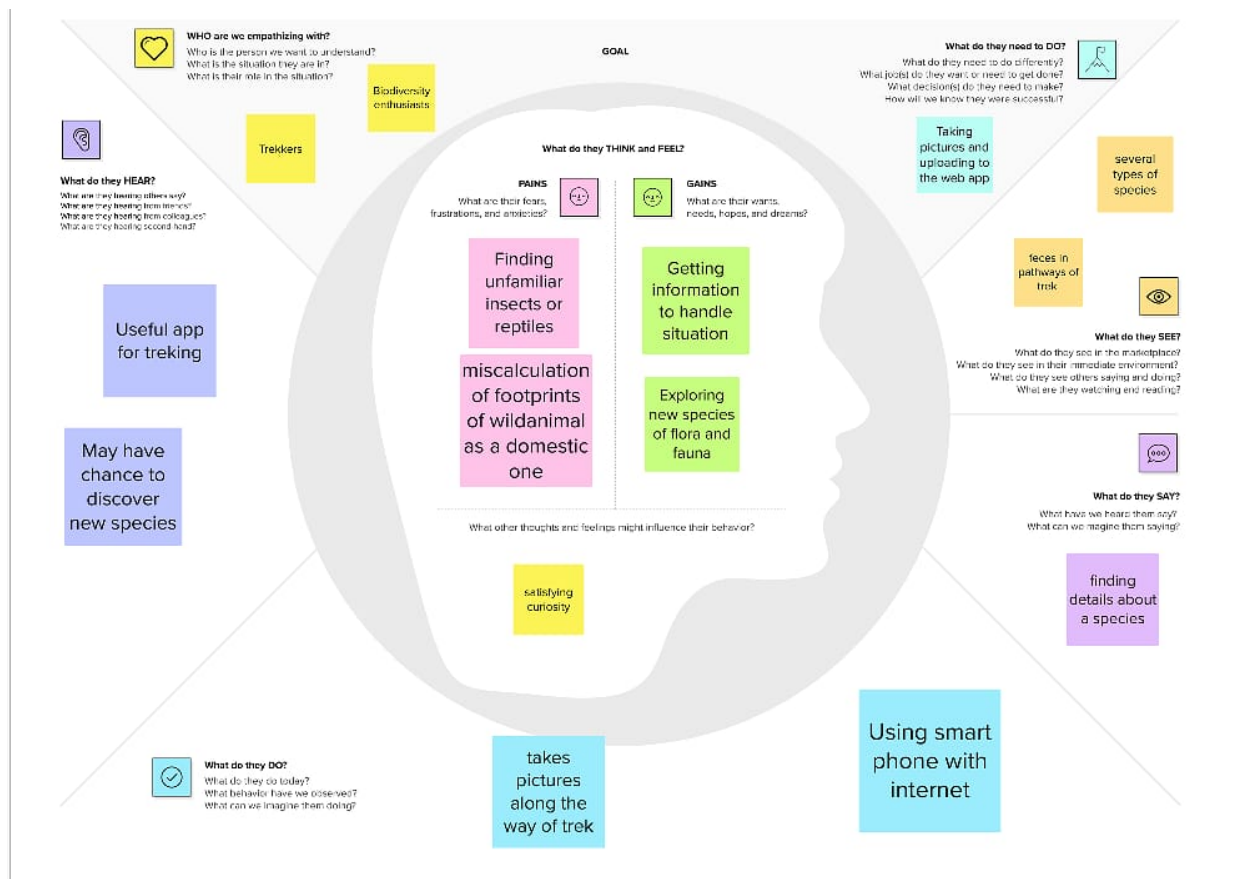
Ideation and brainstorming

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.

Proposed Solution

- 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.

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

Problem Solution Fit

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

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.

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.

Project Design

Data Flow Di
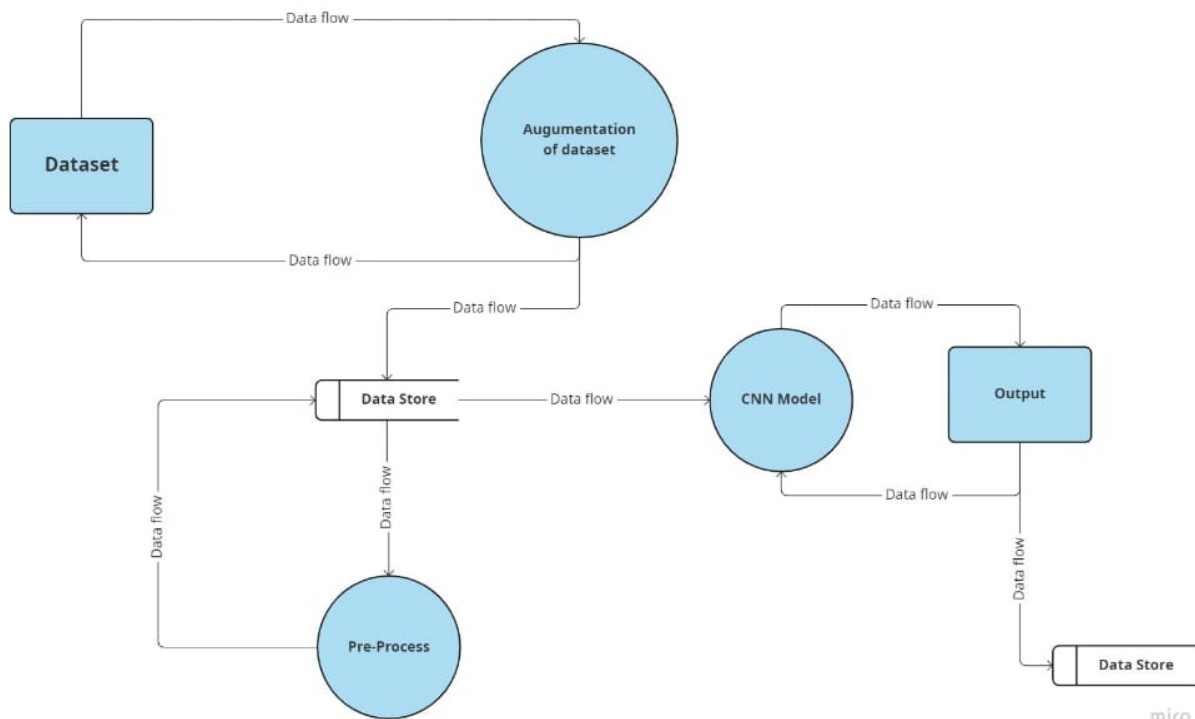
Solution & Technical Archite

```
                    ┌─────────────────────────┐
                    │   Entering The Web app  │
                    └─────────────────────────┘
                                 │
                                 ▼
                        ╱─────────────────╲
              Search───╱   Search/Upload   ╲───Upload
                       ╲                   ╱
                        ╲─────────────────╱
                 │                                    │
                 ▼                                    ▼
        ┌─────────────────┐                 ┌─────────────────┐
        │   Accessing     │                 │   Accessing     │
        │   Camera        │                 │   Camera        │
        └─────────────────┘                 └─────────────────┘
                 │                                    │
                 ▼                                    ▼
         ╱───────────────╲                   ╱───────────────╲
        │    Captured     │                 │    Captured     │
        │     image       │                 │     image       │
         ╲───────────────╱                   ╲───────────────╱
                 │                                    │
                 ▼                                    ▼
         ⬡───────────────⬡                   ⬡───────────────⬡
        │  Pre Processing  │                 │   Labelling the   │
        │   the image      │                 │ image and providing│
         ⬡───────────────⬡                  │ some specification │
                 │                            ⬡───────────────⬡
                 ▼                                    │
        ┌─────────────────┐                           ▼
        │  Checking for   │                 ┌─────────────────────┐
        │   matches       │                 │ Feeding into the model│
        └─────────────────┘                 └─────────────────────┘
                 │
                 ▼
         ⬡───────────────⬡
        │  Displays the   │
        │    result       │
         ⬡───────────────⬡
```
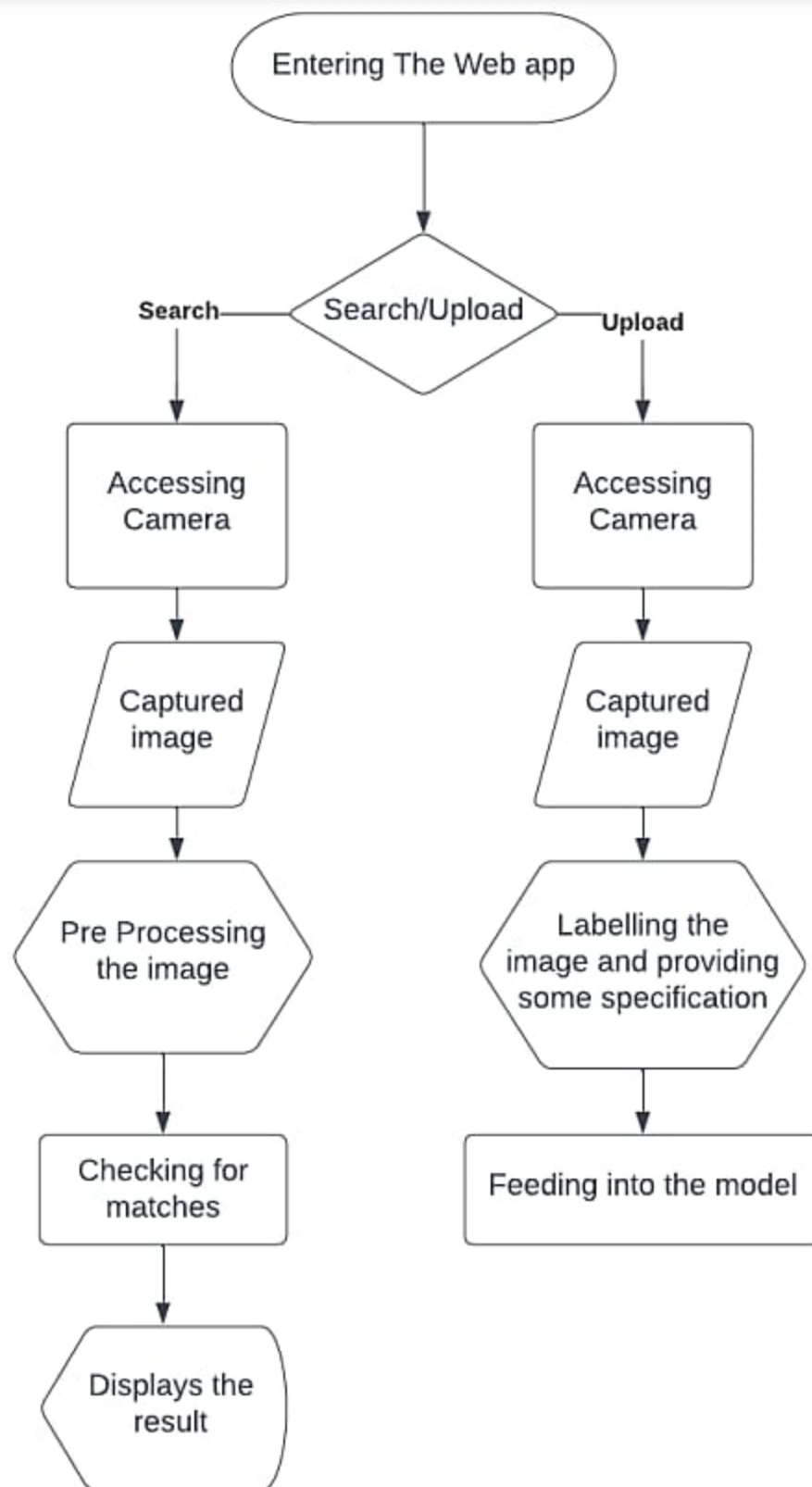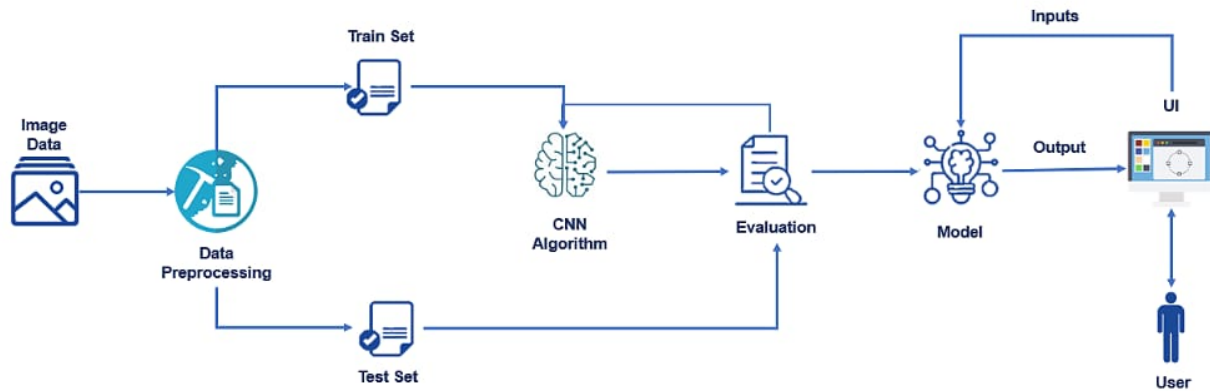
| Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Registration	USN-1	As a user, I can register for the application by Entering my email, and password, and confirming mypassword.	2	High
Sprint-1		USN-2	As a user, I will receive a confirmation email 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

Reports From JIRA
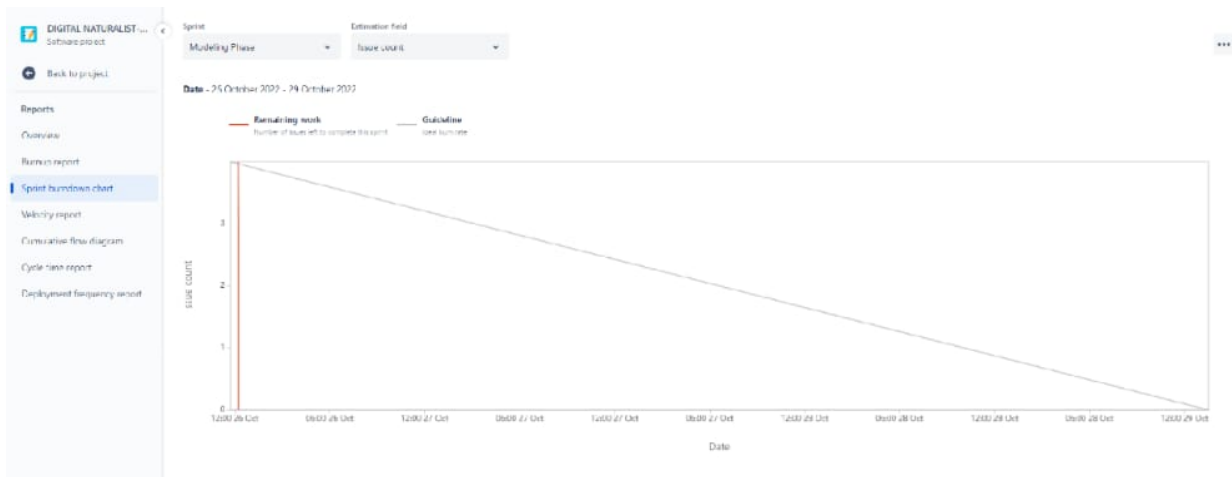
Roadmap
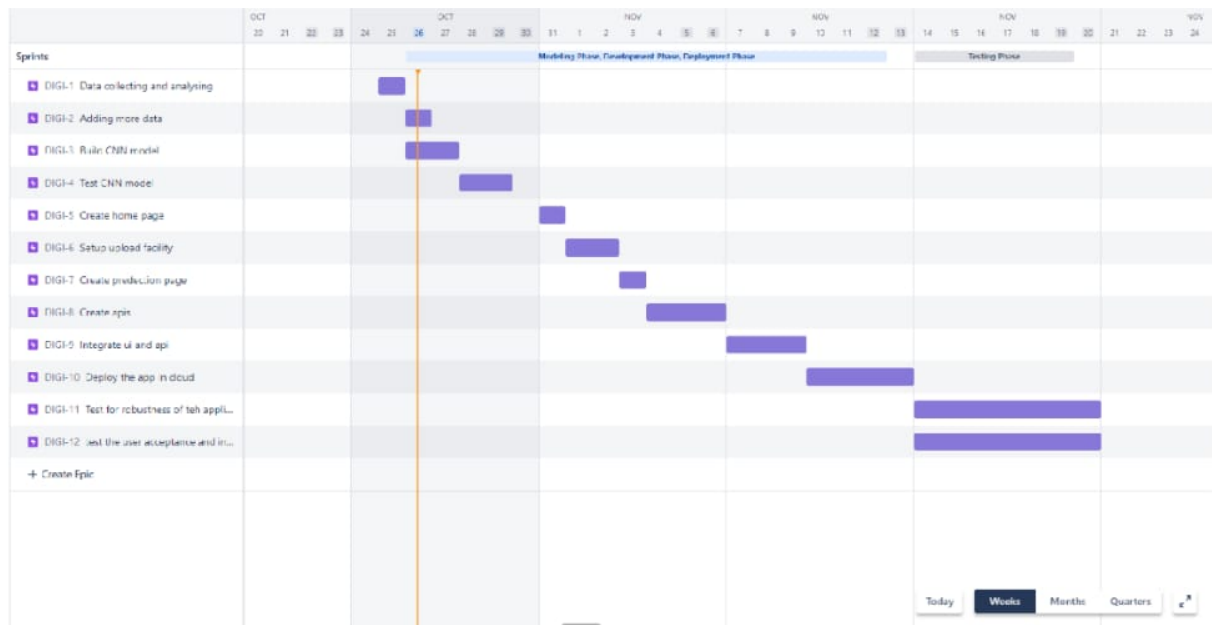
Sprint Delivery Schedule

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		

Results
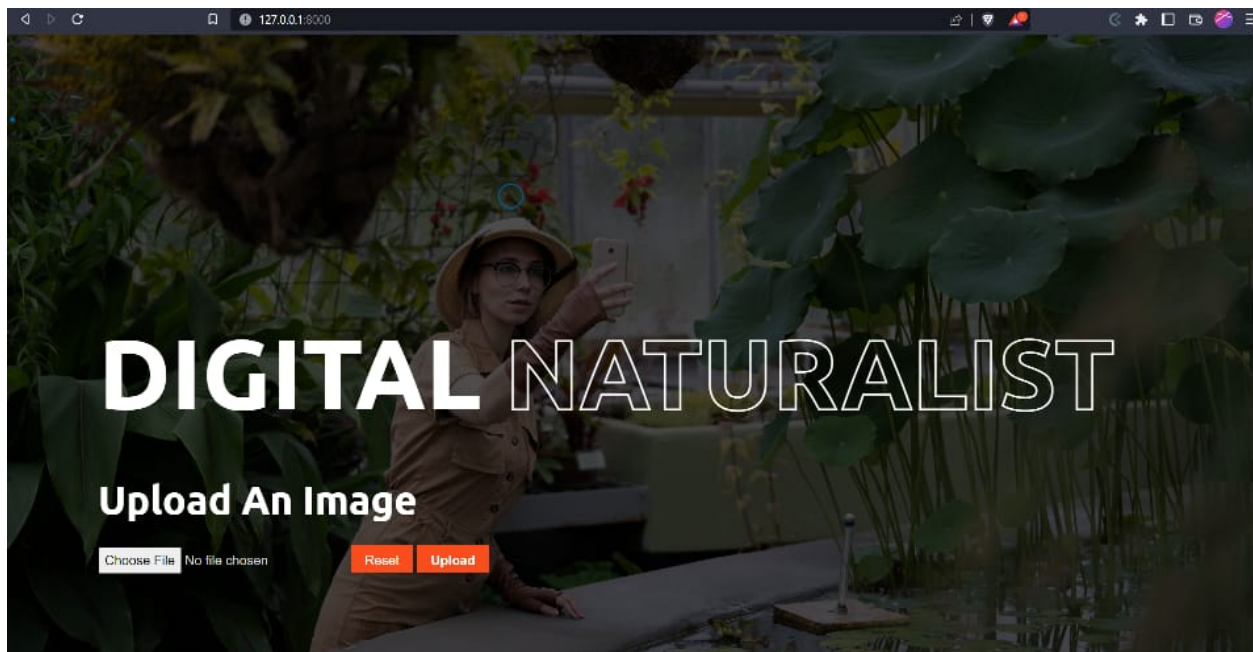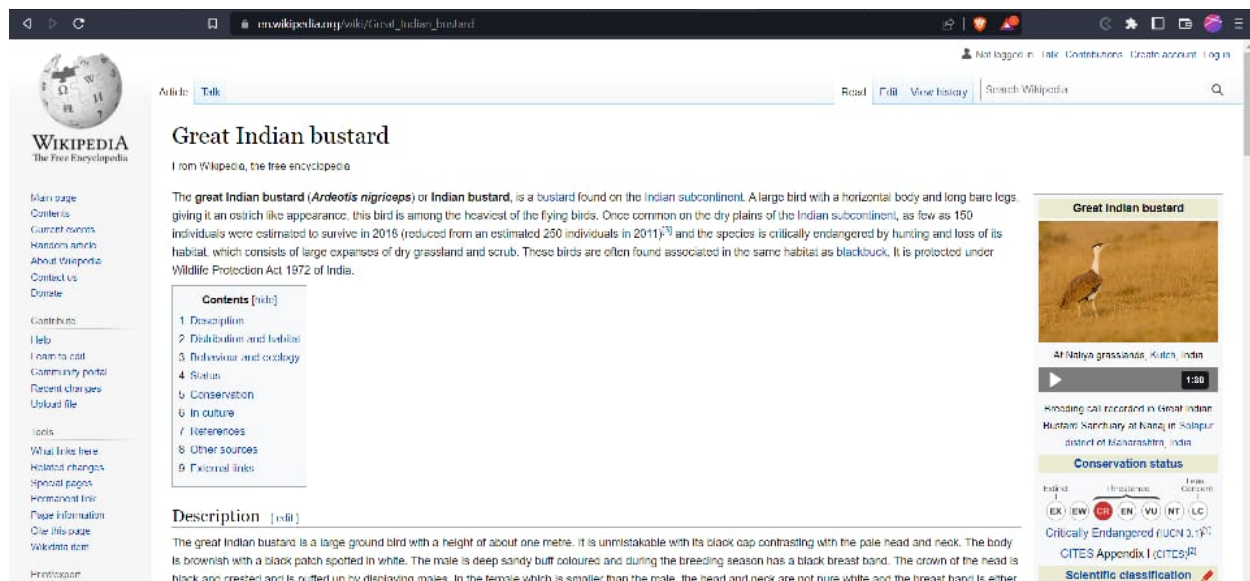
Advantages and Disadvantages

- 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.

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.

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

- which 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 research

DEMO LINK :

https://drive.google.com/file/d/1_ZkVlaJD_TFnrHonfaM33TfaK5LVDon/view?usp=drive
sdk

Github Link : https://github.com/IBM-EPBL/IBM-Project-4741-1658738702