Applied Artificial Intelligence and Machine Learning

Projects in Machine Learning

INFO8665 - Fall 2024 - Section 1

Final Report, Project Documentation and UAT

Group 2
AI-BASED WILD ANIMAL MONITORING AND DETECTION SYSTEM (AI-AMDS)

BY
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Shivam Nyati
Ashwini Seelan Gnanaseelan Vimala

1. URL to our DevOps Project

https://dev.azure.com.mcas.ms/Snyati71210840/Al-AMDS

2. URL to our GitHub Project

https://github.com/Ashwiniseelan3858/Wild-Animal-Detection-

3. MVP for our 3 Use Cases

I. MVP for Wildlife-Human Conflict Prevention in Villages

Objective: Provide timely alerts to villagers and authorities to reduce human-wildlife conflict in rural areas near forests.

Key Features:

- **AI Camera Setup**: Deploy at least one AI-powered camera near a village boundary to detect the presence of wild animals.
- **YOLOv4 Model**: In real-time, implement a basic version of the YOLOv4 object detection model to identify large animals such as elephants or leopards.
- **Real-time Alerts**: Send real-time notifications to villagers via SMS when an animal is detected near the village.
- **Basic Dashboard**: A simple dashboard for local authorities to monitor detected animals and response times.

II. MVP for Protected Wildlife Monitoring in National Parks

Objective: Provide Park rangers with real-time alerts of wildlife activity and potential poaching threats, enabling faster intervention.

Key Features:

- **AI Camera with Night Vision**: Install a limited number of AI cameras with night vision in strategic areas of the park.
- **Wildlife and Human Detection**: Use a simplified version of the YOLOv4 model to detect both wildlife (endangered species) and unauthorized human presence in real time.
- **Geofencing Alerts**: If unauthorized humans are detected in restricted zones, send alerts to park rangers via an app or SMS.
- **Basic Cloud Storage**: Store captured footage of wildlife and unauthorized activity for future analysis.
- **Ranger Mobile App**: A simple mobile app to display notifications and camera feeds to park rangers.

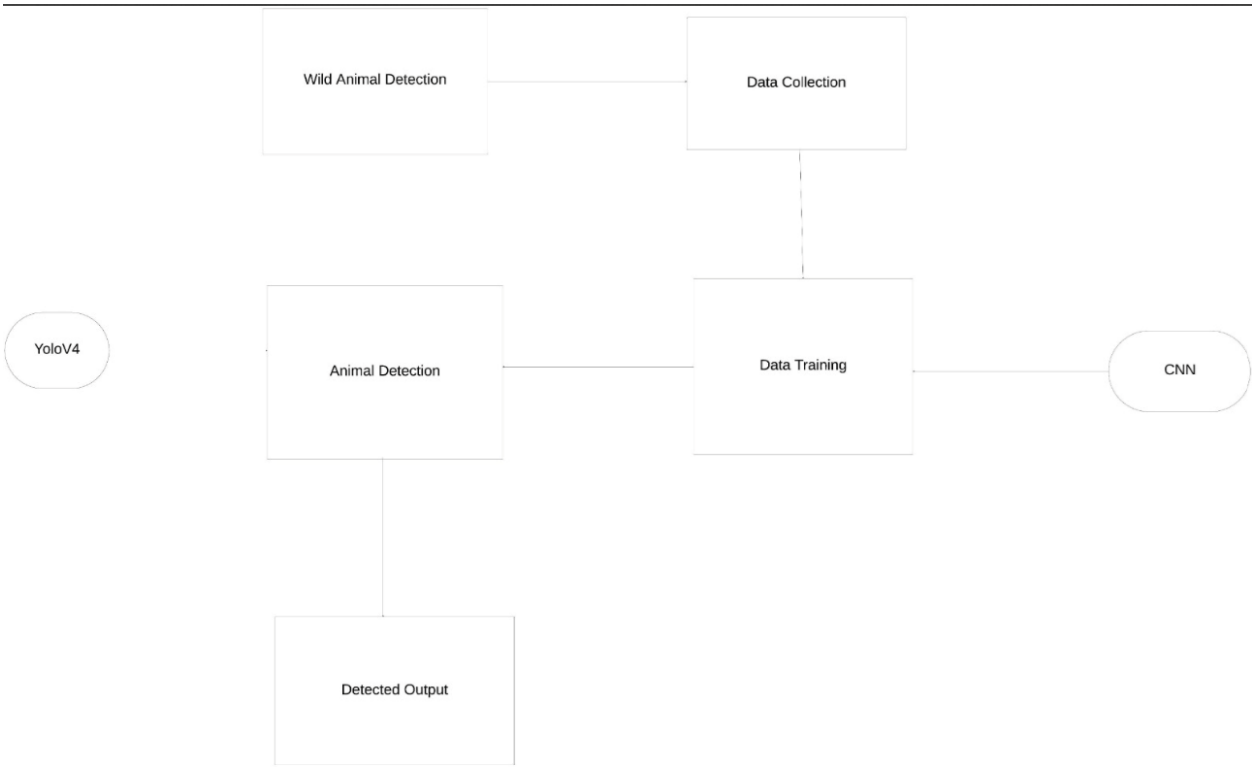
III. MVP for Early Warning System for Hikers and Tourists

Objective: Offer hikers a real-time wildlife detection alert system that increases safety and prevents dangerous encounters on trails.

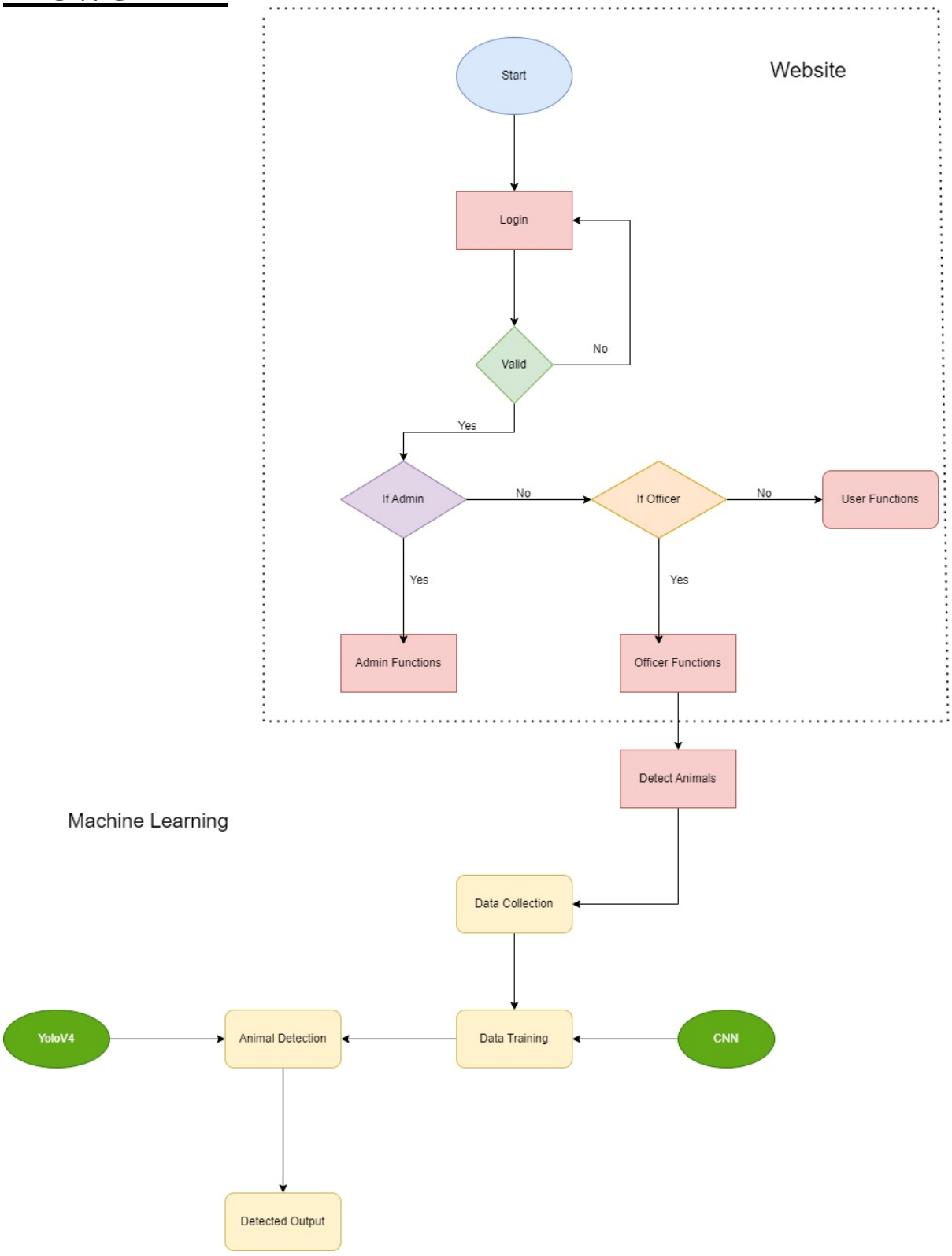
Key Features:

- **AI Cameras on Trails**: Install AI-powered cameras along a small section of a popular hiking trail.
- **Wild Animal Detection**: Implement a basic YOLOv4 model to detect common wild animals found in the area (e.g., bears or large mammals).
- **Mobile App for Alerts**: Develop a simple mobile app for hikers that sends notifications when animals are detected on the trail.
- **GPS Tracking and Alternative Routes**: Include a basic GPS feature in the app to show hikers their location and suggest alternative paths when an animal is detected.
- **App Feedback Loop**: Allow hikers to provide feedback on sightings and receive safety tips via the app.

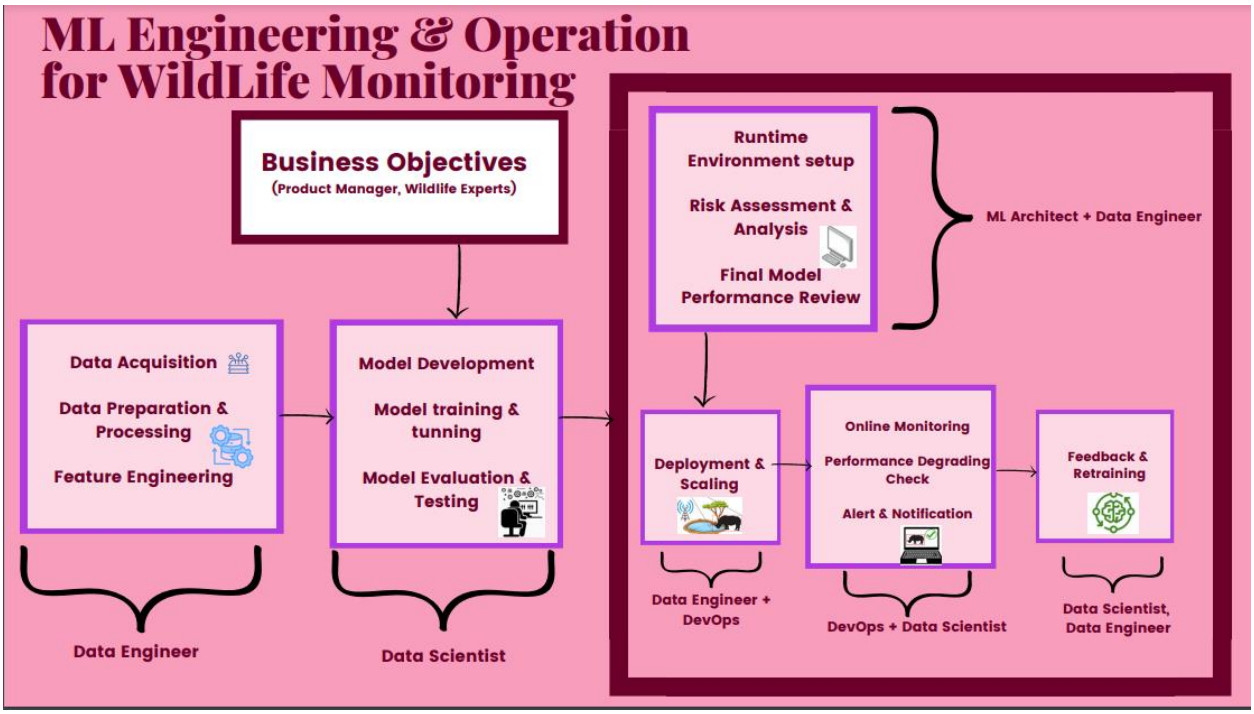
ARCHITECTURE DESIGN



FLOWCHART


Website
Start
Login
Valid
No
Yes
If Admin
No
If Officer
No
User Functions
Yes
Yes
Admin Functions
Officer Functions
Detect Animals
Machine Learning
Data Collection
YoloV4
Animal Detection
Data Training
CNN
Detected Output

ML Engineering and Operational Design:



- Data Engineer:
  - ✓ Data Acquisition: Collects wildlife images, GPS data, and sensor data from sources like cameras and drones.
  - ✓ Data Preparation & Processing: Prepares the raw data by cleaning, normalizing, and handling missing values.
  - ✓ Feature Engineering: Extracts key features for the model (e.g., animal types, metadata like location, time, etc.).

- Data Scientist:
  - ✓ Model Development: Develops machine learning models using techniques like CNNs and YOLO for image classification and object detection.
  - ✓ Model Training & Tuning: Trains models on the prepared dataset and tunes hyperparameters for optimal performance.
  - ✓ Model Evaluation: Validates the trained models using performance metrics such as precision, recall, F1-score, and accuracy.

- ML Architect + Data Engineer:
  - ✓ Runtime Environment Setup: Sets up a production-ready environment using Kubernetes or Docker for scalable, real-time processing.
  - ✓ Risk Assessment & Analysis: Evaluates the risks (e.g., misclassification) and ensures the model is safe and accurate before deployment.
  - ✓ Final Performance Review: Ensures the model's production performance aligns with the system's requirements and safety standards.

- Data Engineer + DevOps:
  - ✓ Deployment & Scaling: Deploys the trained models using a CI/CD pipeline. Manages autoscaling to adapt to changing demands in real-time processing.
  - ✓ Online Monitoring: Ensures that the deployed models are monitored in real-time for accuracy and performance degradation.

- DevOps + Data Scientist:
  - ✓ Performance Degradation Monitoring: Continuously checks for model drift or performance degradation and triggers retraining cycles if needed.
  - ✓ Alerts & Notifications: Sets up real-time alerts for rangers, authorities, or residents based on the detection of wildlife or human activity conflicts.

- Feedback & Retraining (Data Scientist, Data Engineer):
  - ✓ Feedback Loop: Continuously collects feedback from end users (rangers, wildlife experts, etc.) and retrains the model to improve accuracy and performance.

Dataset

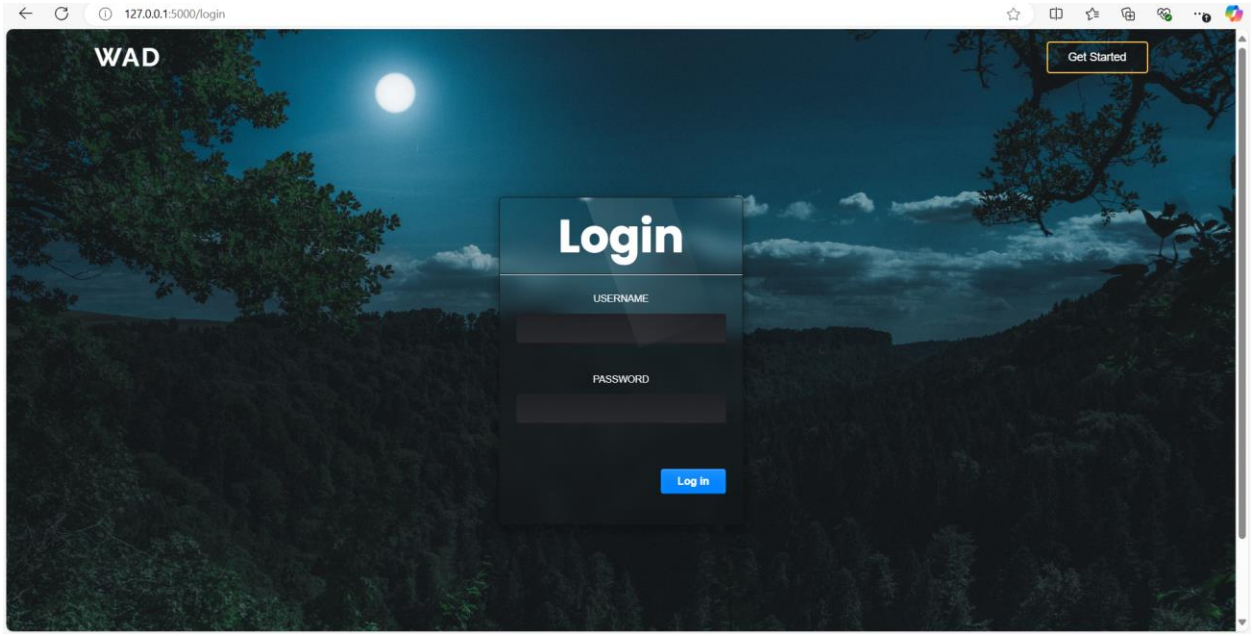
Our project utilizes a pre-trained dataset for weapon detection using the YOLO model. While we were making our project available on GitHub, we were unable to upload the dataset due to its size of 300MB.

Some of our codes, such as training data, training model, and Android code, are unable to be attached to the zip file due to their excessive file size.

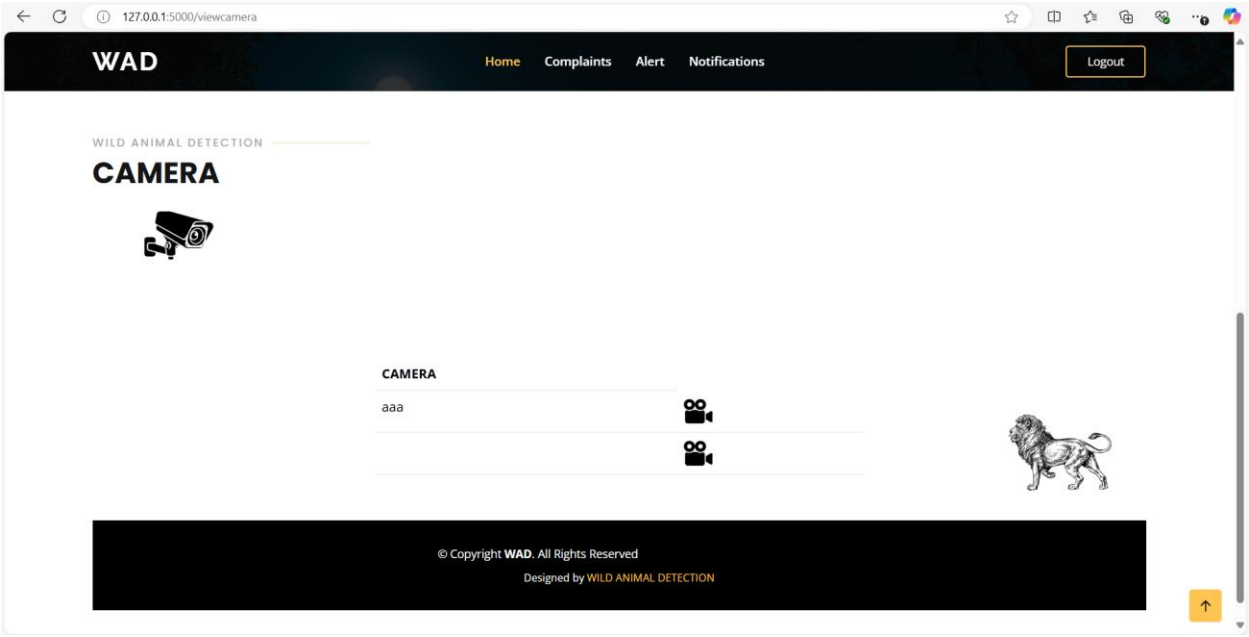
4. Screenshot of the application:

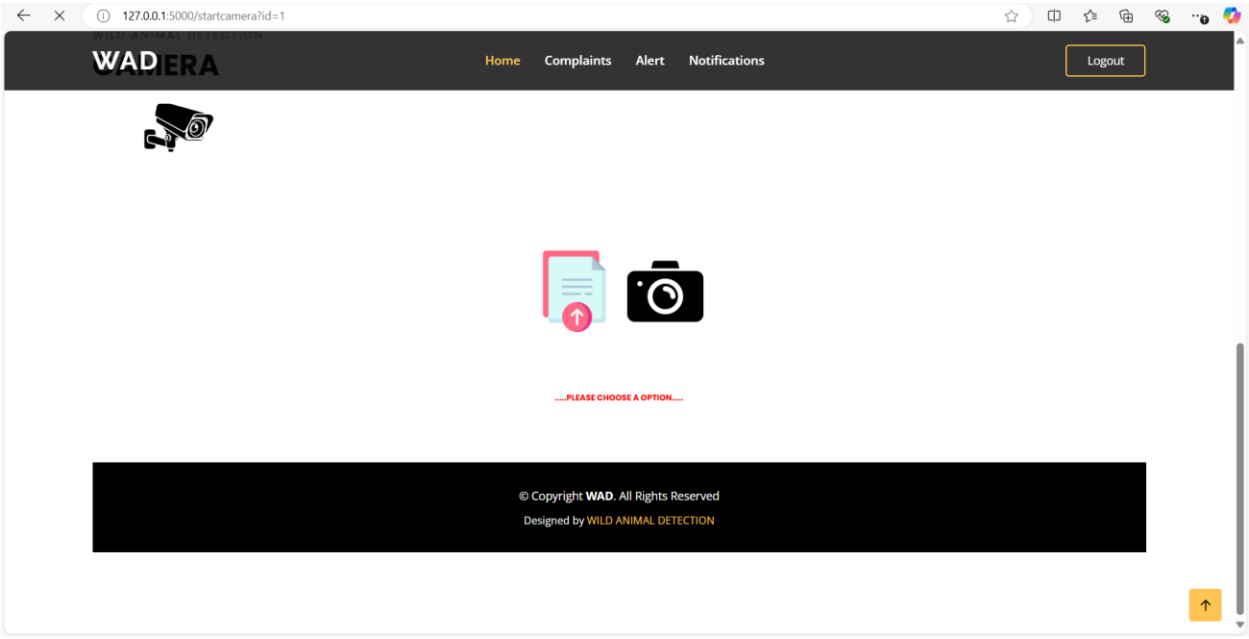
Start page:

Login page:

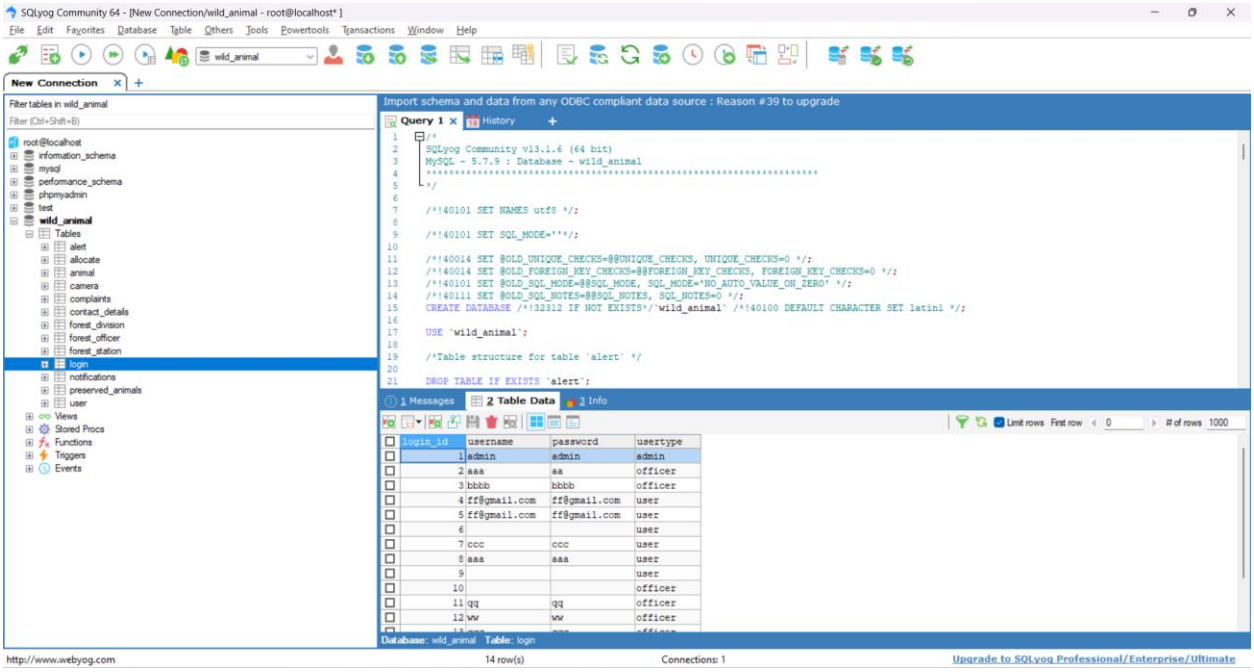


Camera Functionality:

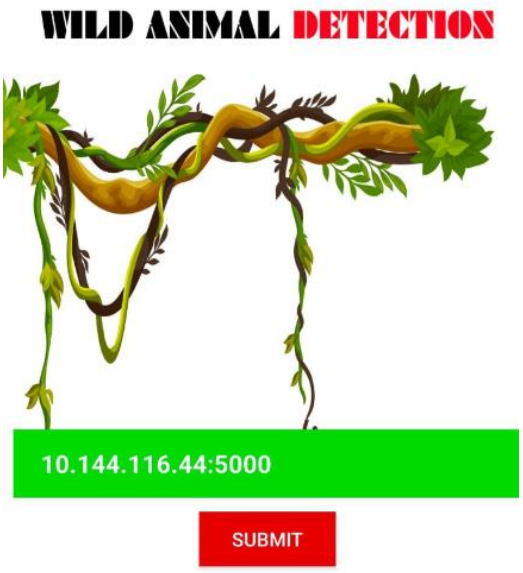


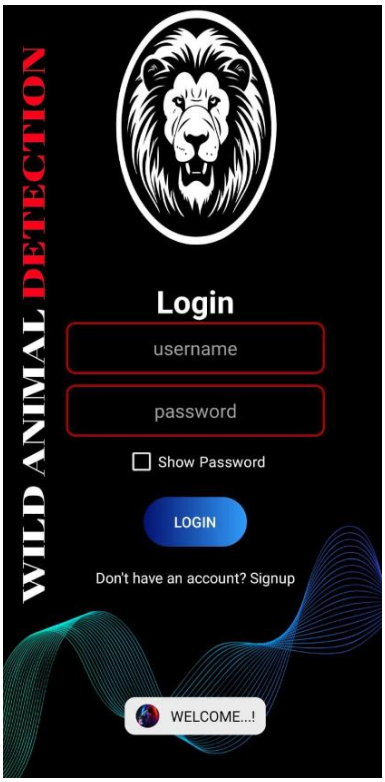


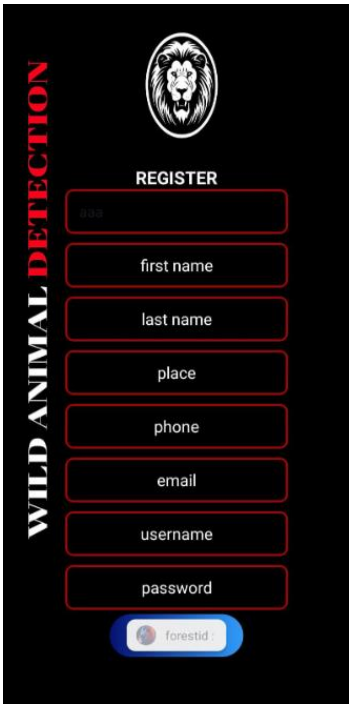
Database:



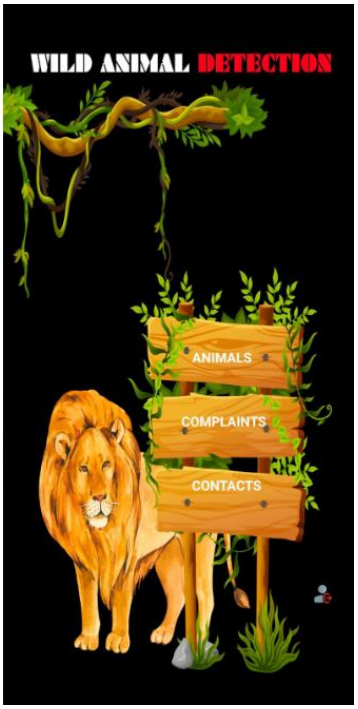
Android Application Screenshots:

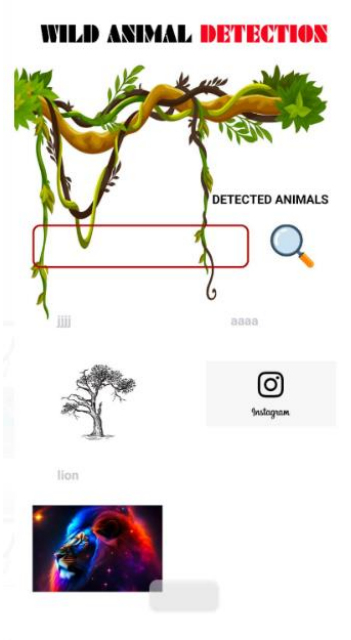


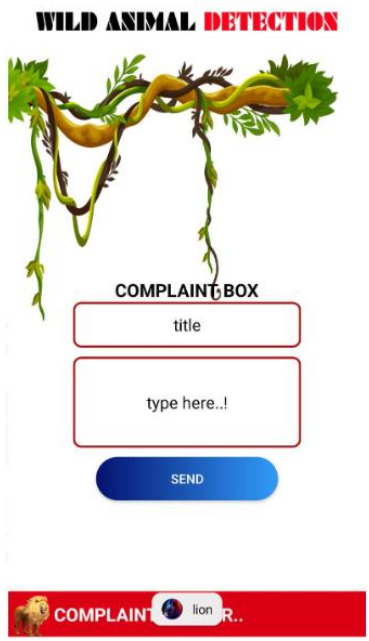


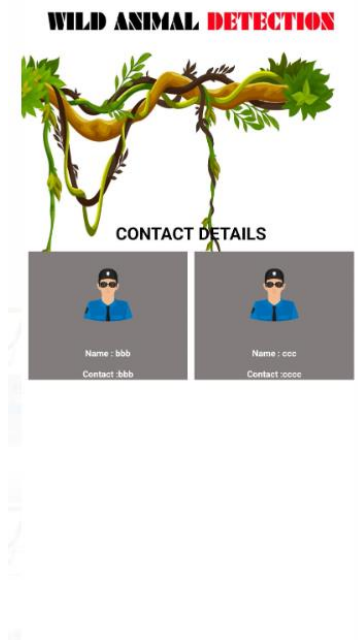

WILD ANIMAL DETECTION
REGISTER
aaa
first name
last name
place
phone
email
username
password
forestid


"A truly strong person does not need the approval of others any more than a lion needs the approval of sheep."
There's always the hyena of morality at the garden gate, and the real wolf at the end of the street.
Pronghorn antelope were the second fastest mammals on earth—only an African cheetah could outrun them.
START NOW..


WILD ANIMAL DETECTION
ANIMALS
COMPLAINTS
CONTACTS

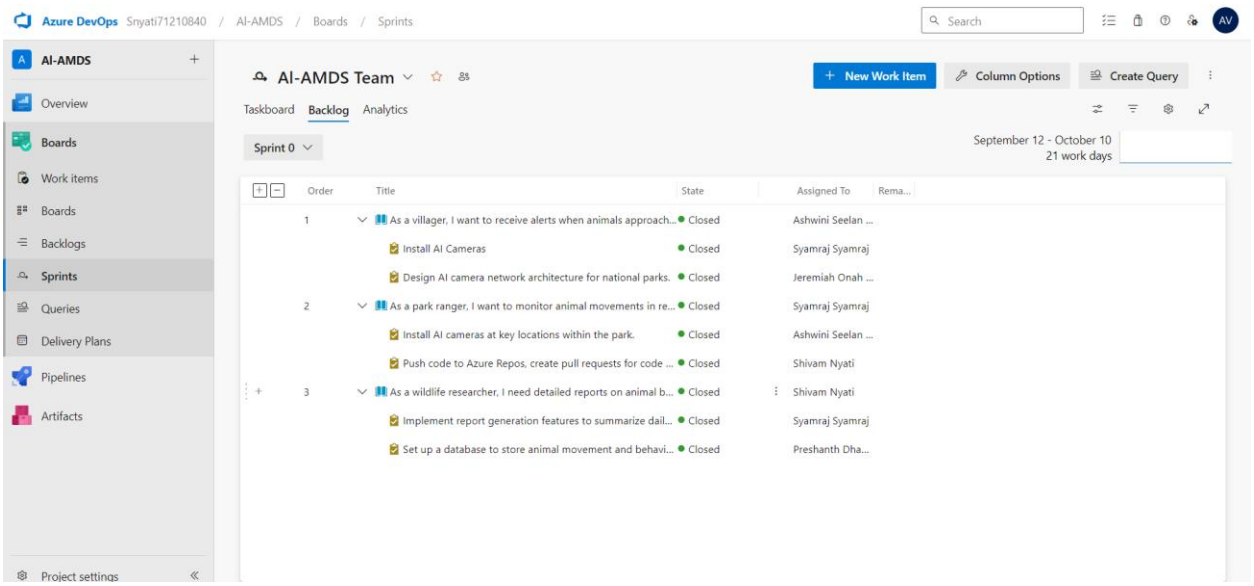

WILD ANIMAL DETECTION
DETECTED ANIMALS
jjjj
aaaa
Instagram
lion


WILD ANIMAL DETECTION
COMPLAINT BOX
title
type here..!
SEND
COMPLAINT
lion
R..

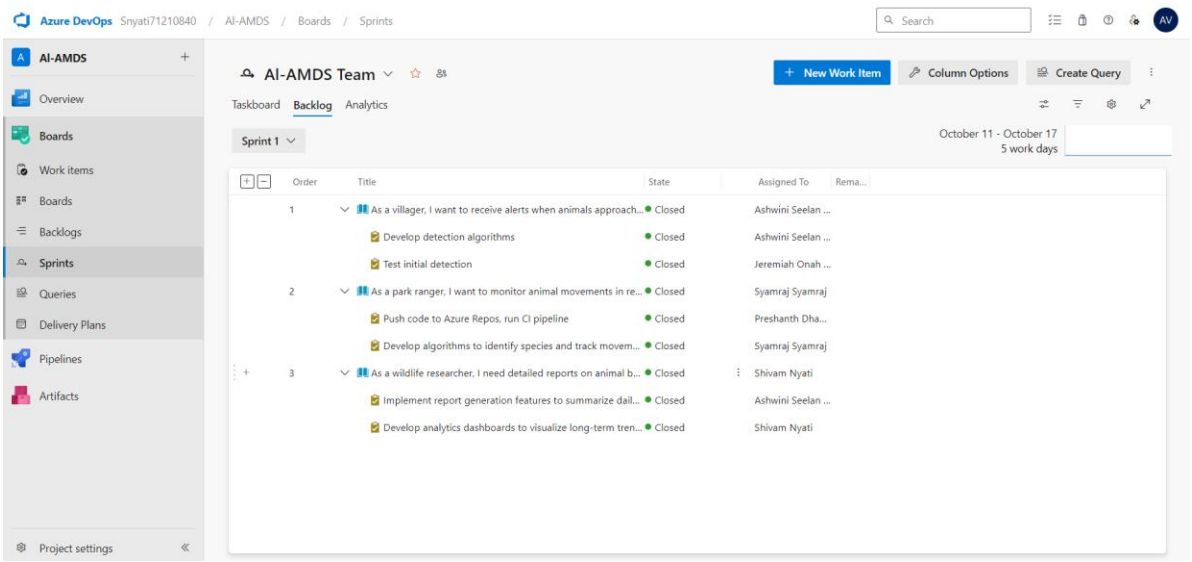

WILD ANIMAL DETECTION
CONTACT DETAILS
Name : bbb
Contact :bbb
Name : ccc
Contact :cccc

5. AZURE DEVOPS BOARD:

SPRINT 0 CLOSED:



SPRINT 1 CLOSED:



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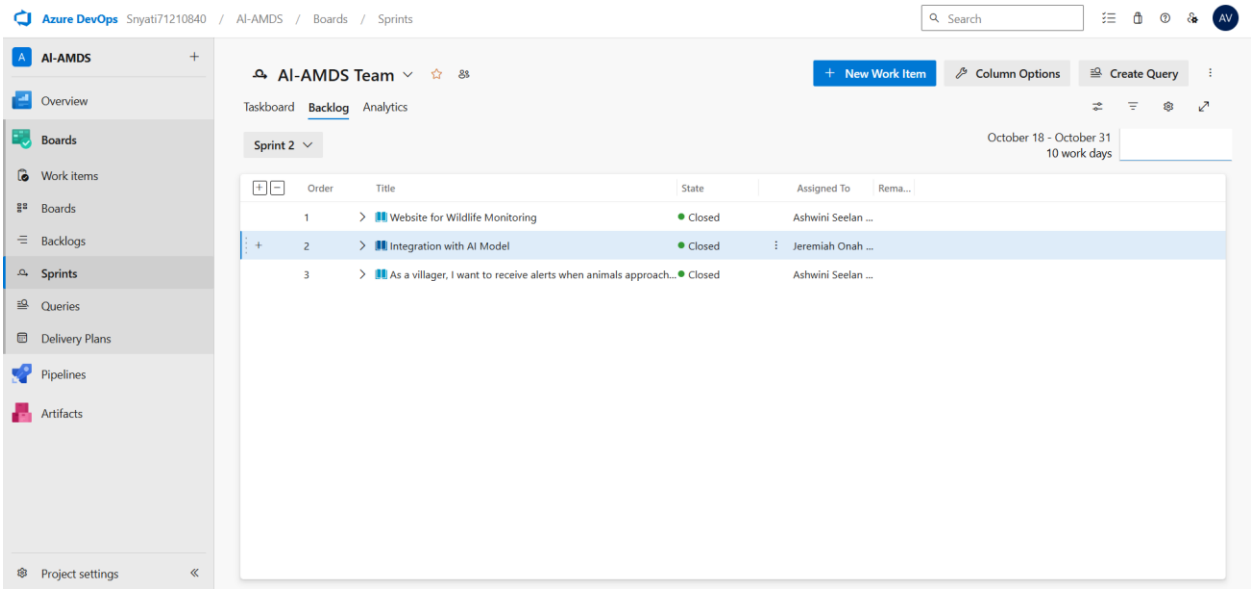

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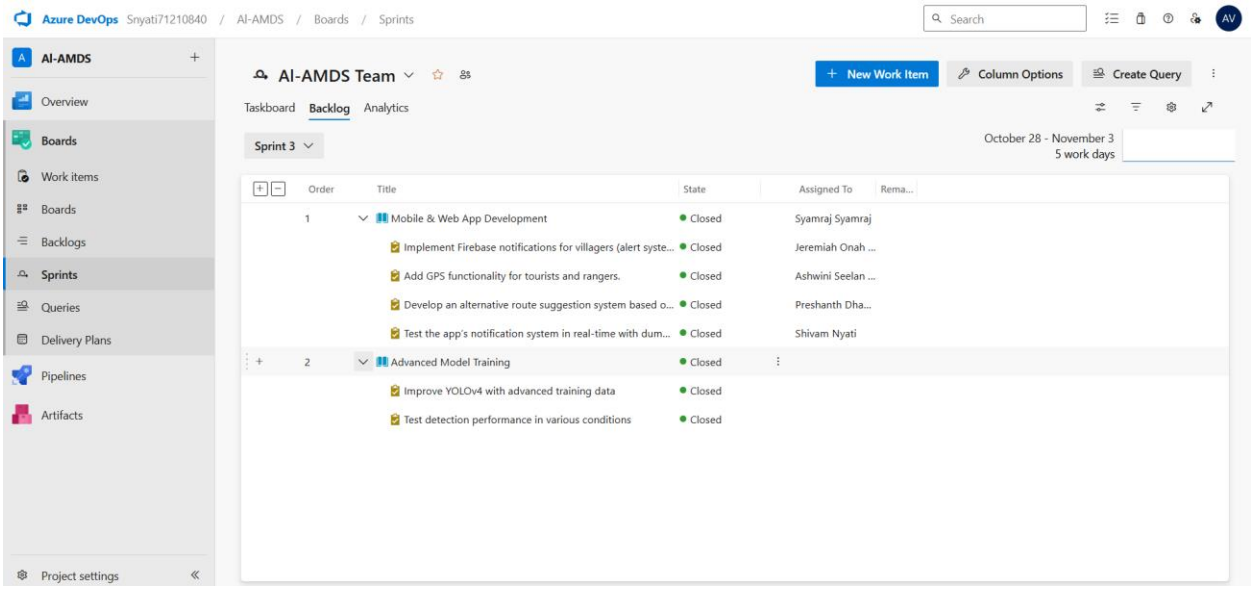

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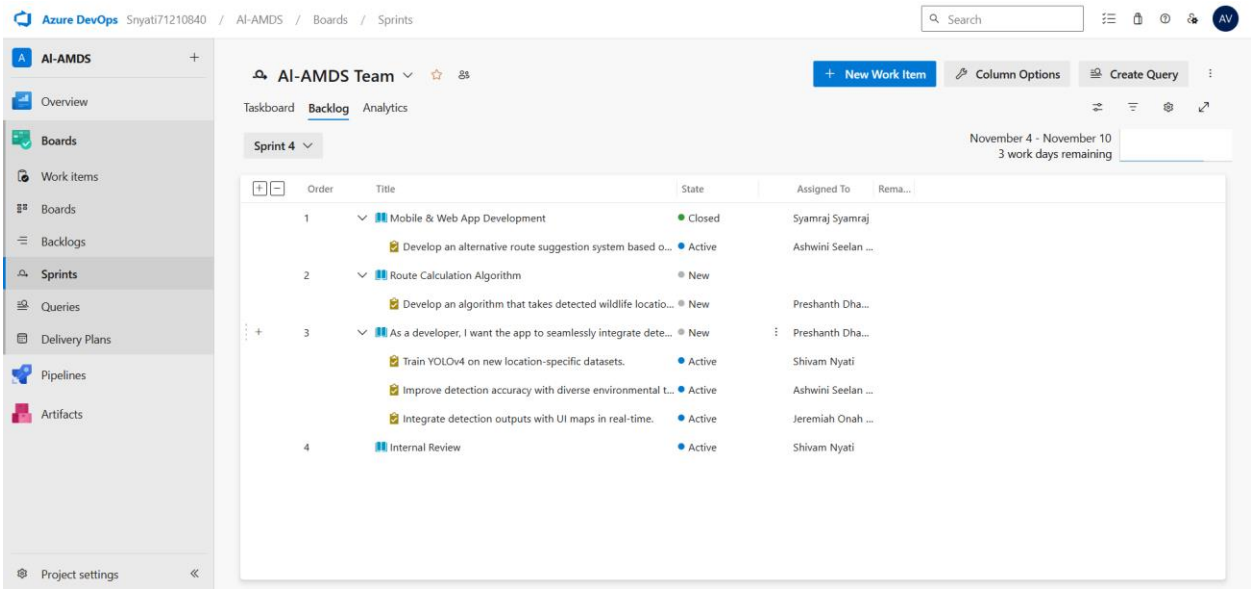
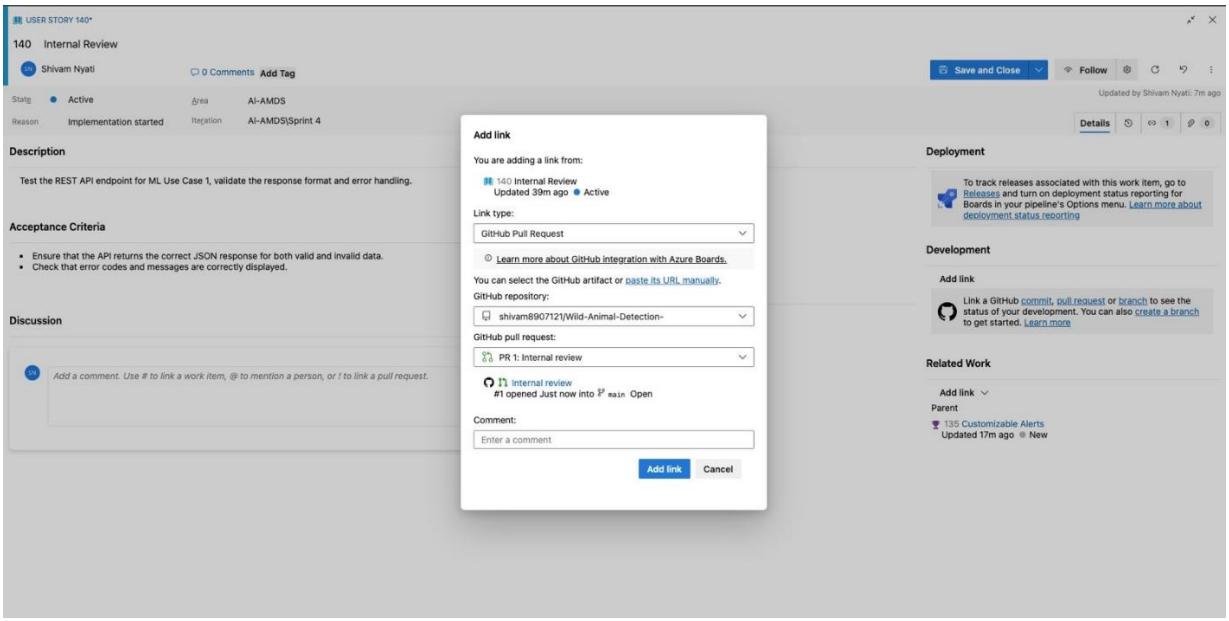
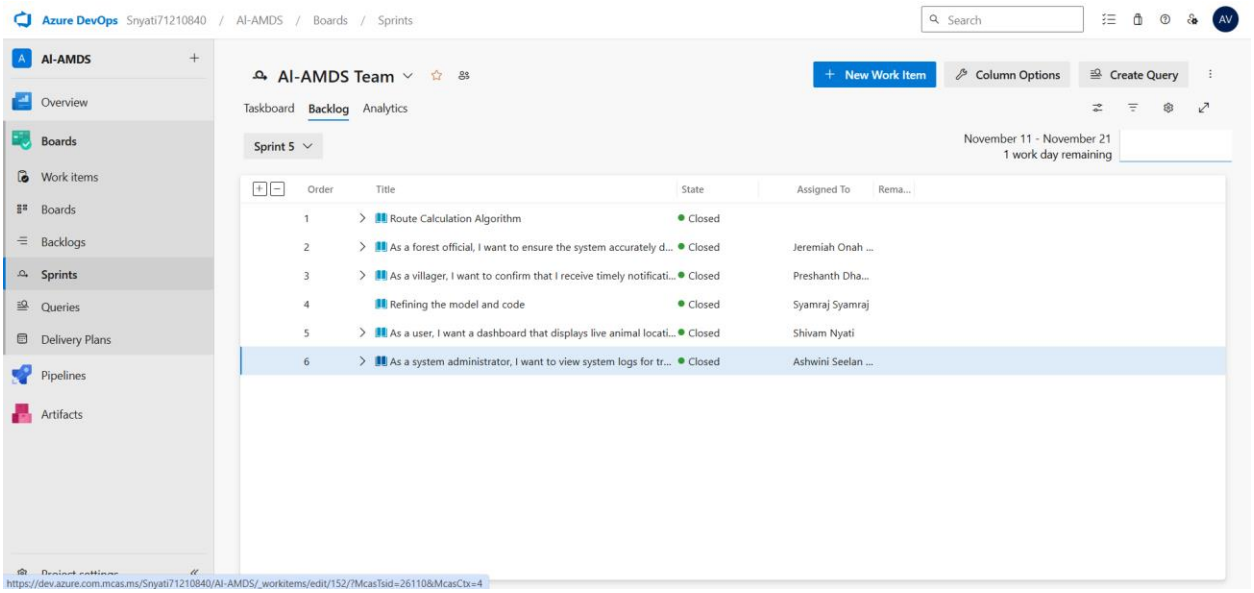


Internal Review:

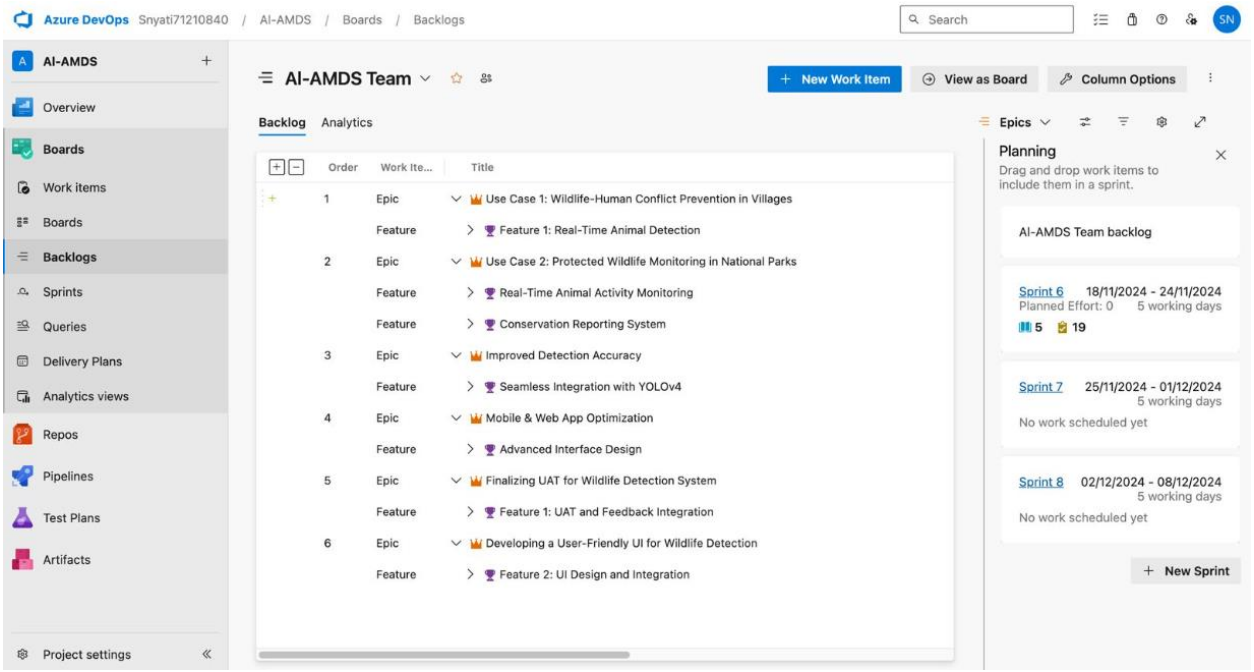


SPRINT 5 CLOSED:



Order	Title	State	Assigned To	Remaining Work	Work Item Ty...	Activity
1	As a forest official, I want to ensure the system accuratel...	New	Jeremiah Onah Oto...		User Story	
	Prepare UAT test cases for animal detection with exp...	New			Task	
	Conduct functional testing to validate detection accur...	New			Task	
	Simulate edge cases (e.g., rare species, environment...	New			Task	
	Log results of UAT tests and identify discrepancies.	New			Task	
	Retest the system after refining detection algorithms.	New			Task	
2	As a villager, I want to confirm that I receive timely notifi...	New	Preshanth Dhanapal		User Story	
	Develop test cases to validate the notification system'...	New			Task	
	Test notifications in different scenarios (e.g., varied a...	New			Task	
	Validate language settings for notifications to ensure l...	New			Task	
	Collect feedback from villagers during a UAT session.	New			Task	
3	Refining the model and code	Closed	Syamraj Syamraj		User Story	
	Model improvements	Closed			Task	
	Code Refinements	Closed			Task	
4	As a user, I want a dashboard that displays live animal lo...	New	Shivam Nyati		User Story	
	Design the dashboard layout with maps and status in...	New			Task	

4	As a user, I want a dashboard that displays live animal lo...	New	Shivam Nyati	User Story
	Design the dashboard layout with maps and status in...	New		Task
	Integrate real-time data from detection systems into t...	New		Task
	Test the functionality of status indicators (e.g., Safe, ...	New		Task
	Validate the accuracy of live data visualizations.	New		Task
5	As a system administrator, I want to view system logs for...	New	Ashwini Seelan Gna...	User Story
	Develop a log viewer interface with filtering capabiliti...	New		Task
	Implement real-time log updates in the UI.	New		Task
	Test log search and filter functionality (e.g., by date, e...	New		Task
	Ensure the logs provide detailed information for troubl...	New		Task



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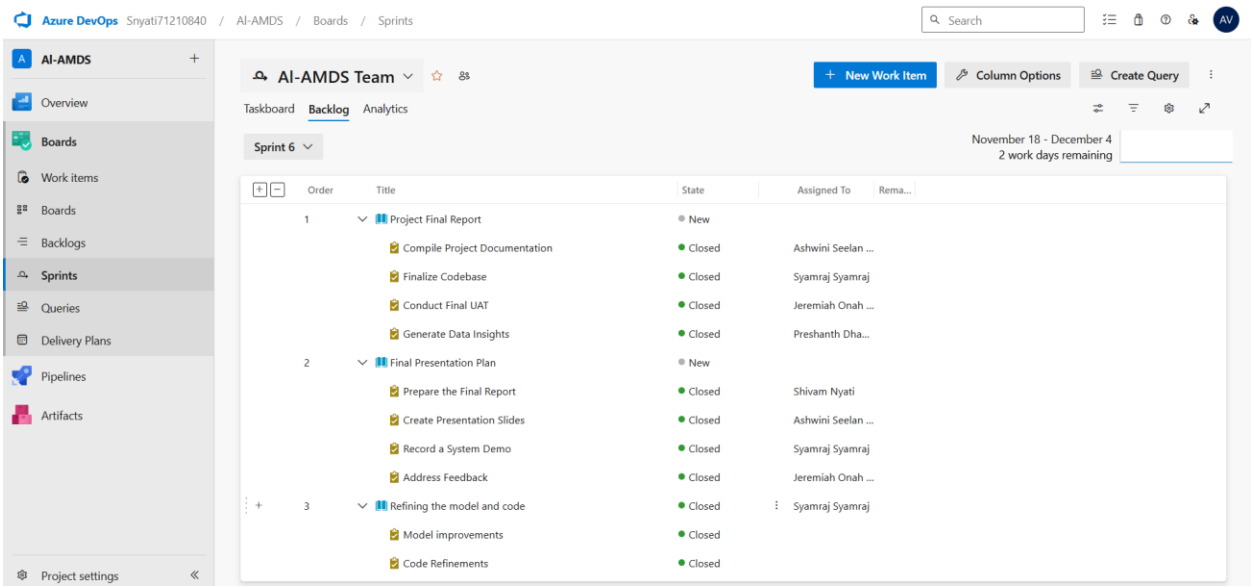

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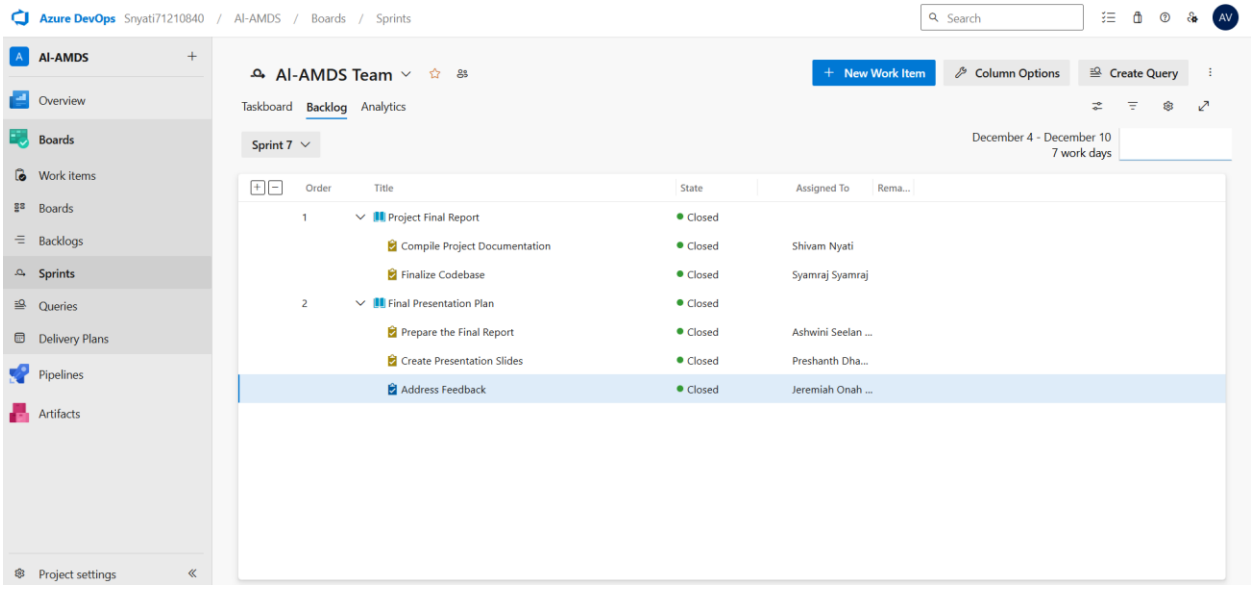
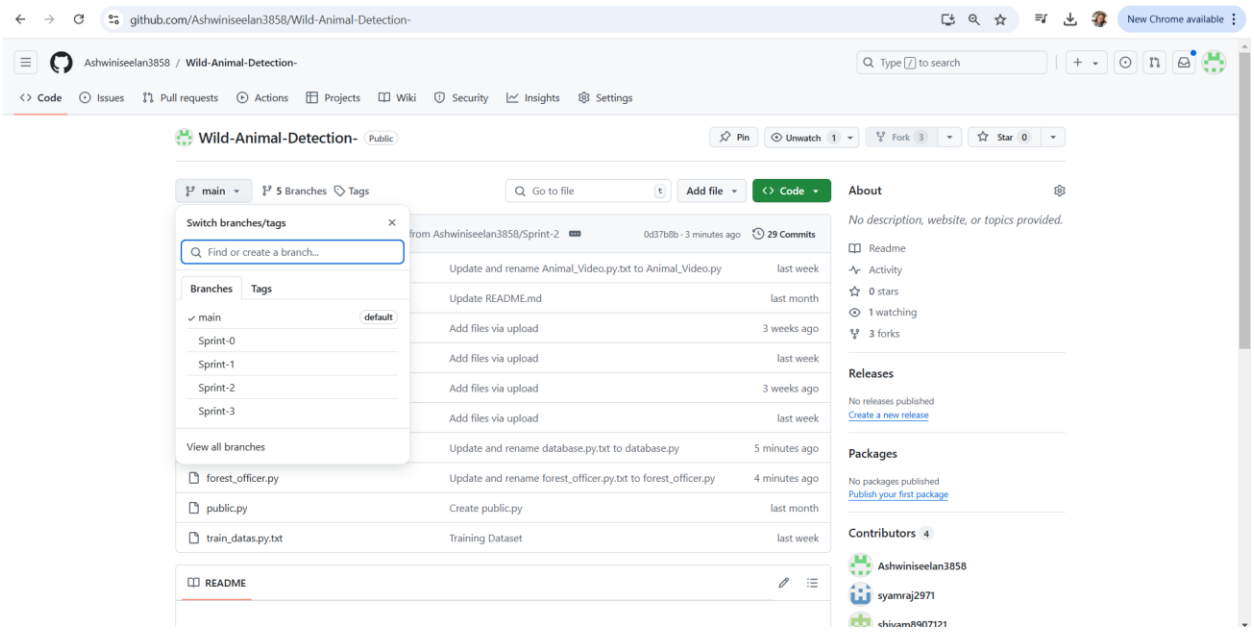
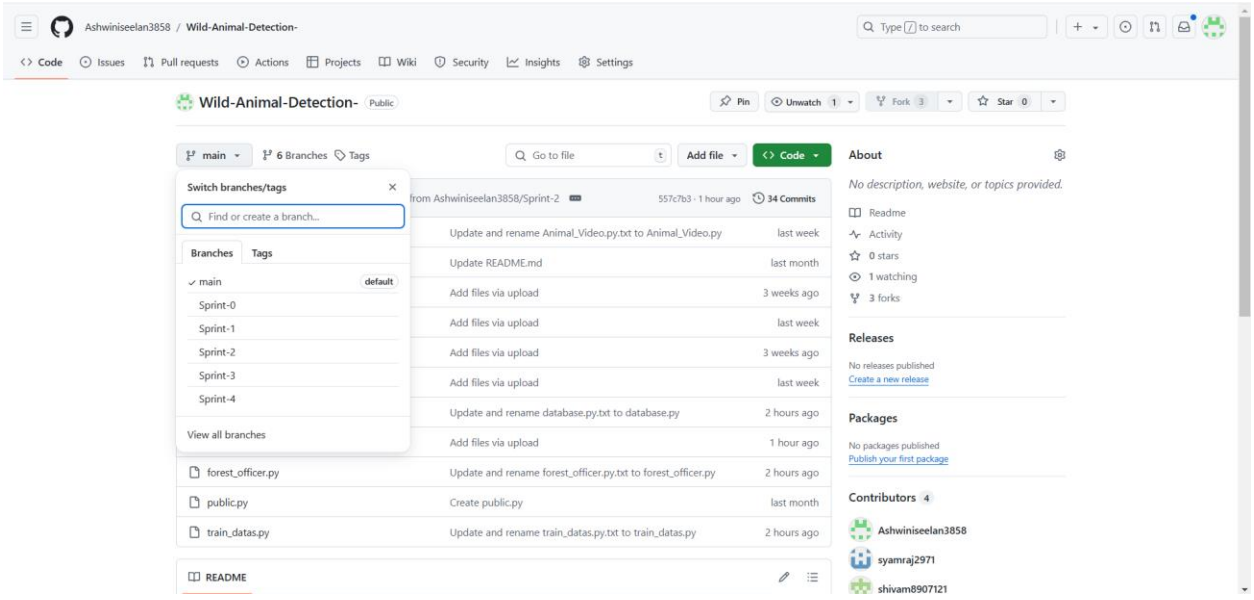
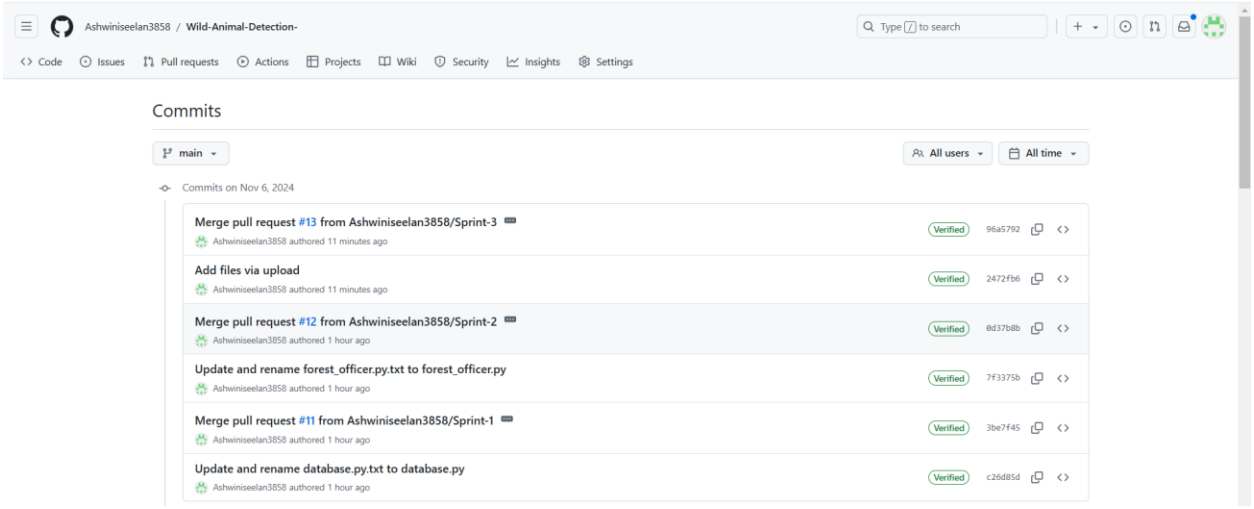


GITHUB REPOSITORY:

SPRINT 3 and 4 Branch created.







6. Link To Pull Request

https://github.com/Ashwiniseelan3858/Wild-Animal-Detection-/pulls?q=is%3Aopen+is%3Apr

https://github.com/Ashwiniseelan3858/Wild-Animal-Detection-/commits/Sprint-3

References

- Velastin S. A., Boghossian B. A., and Vicencio-Silva M. A., A motion-based image processing system for detecting dangerous situations in underground railway stations, Transportation Research Part C: Emerging Technologies. (2006) 14, no. 2, 96–113, https://doi.org/10.1016/j.trc.2006.05.006, 2-s2.0-33746377916.

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