

# **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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Preshanth Dhanapal

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## 1. URL to our DevOps Project

<https://dev.azure.com/mcas.ms/Snyati71210840/AI-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.

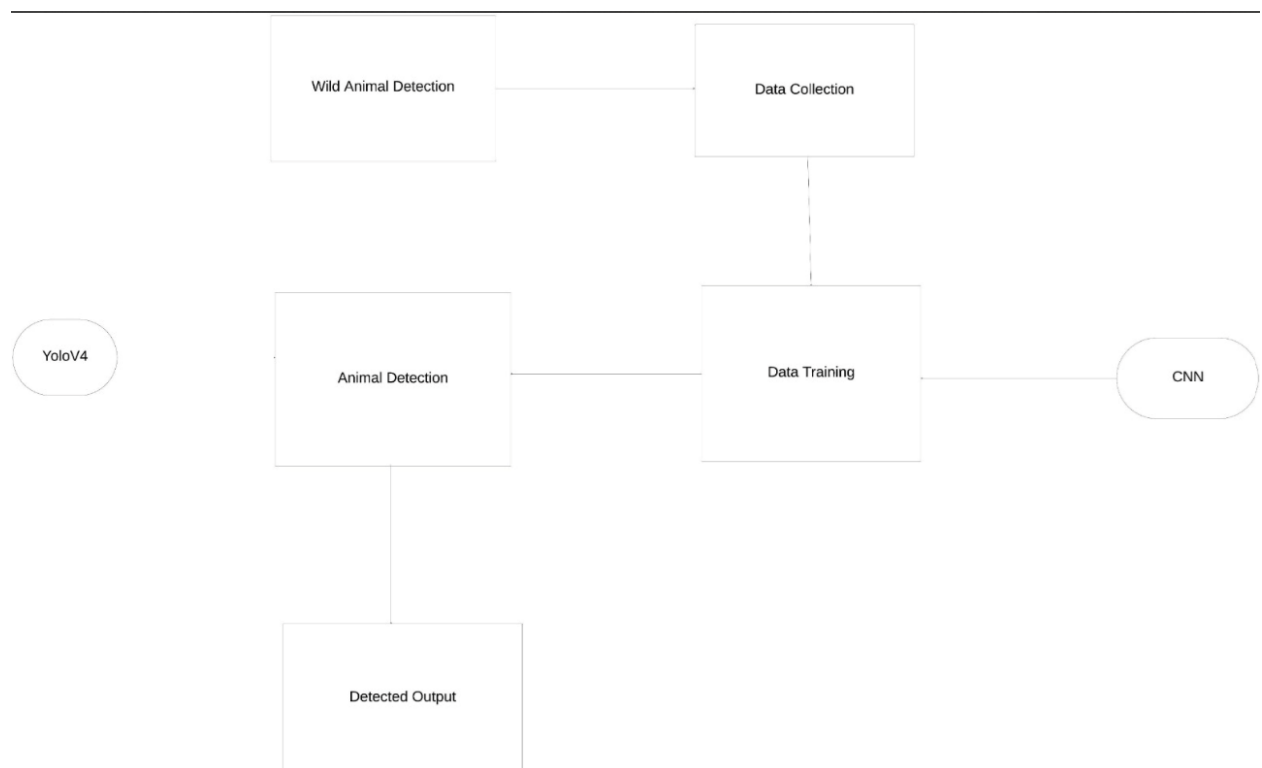
### III. MVP for Early Warning System for Hikers and Tourists

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

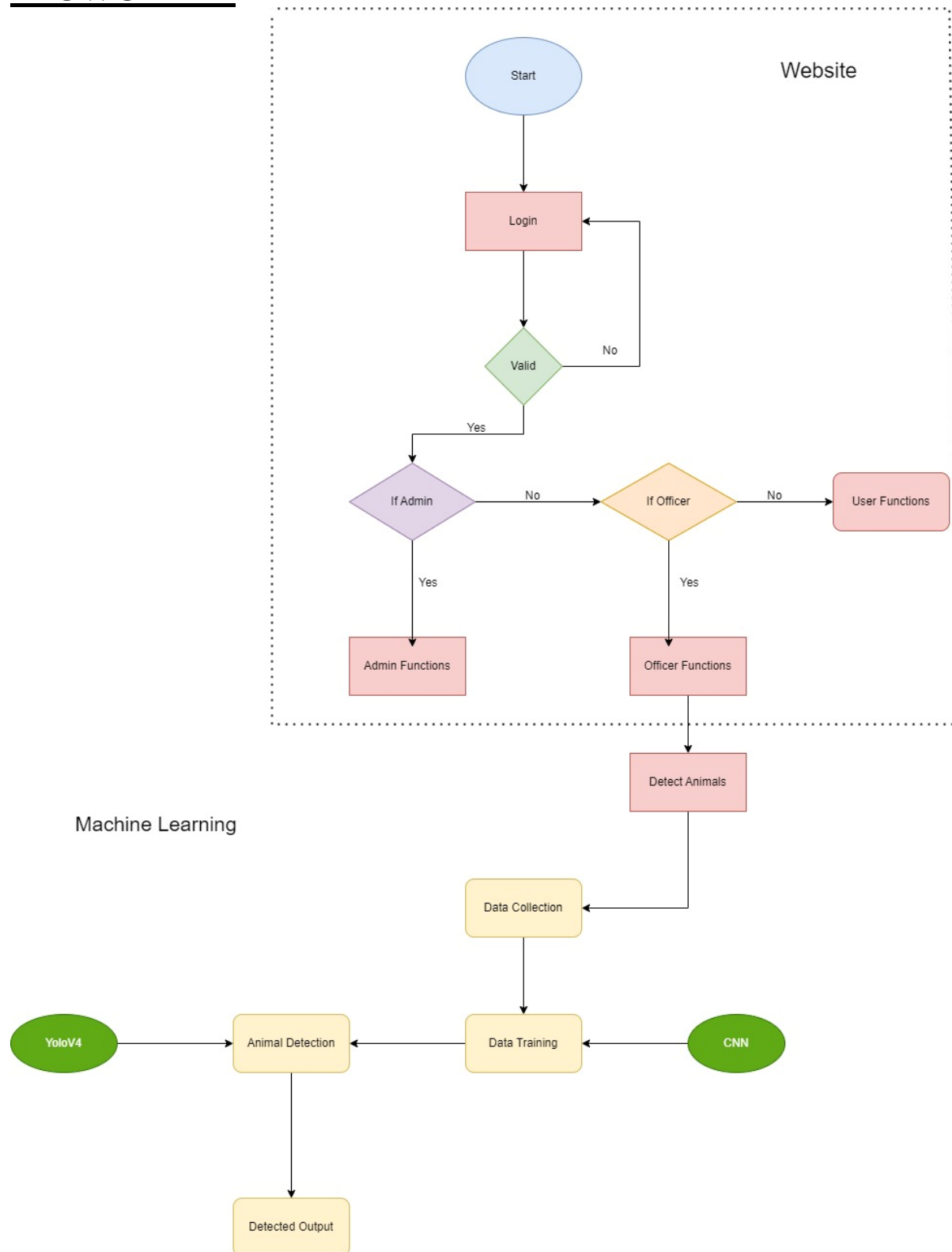
**Key Features:**

- **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.

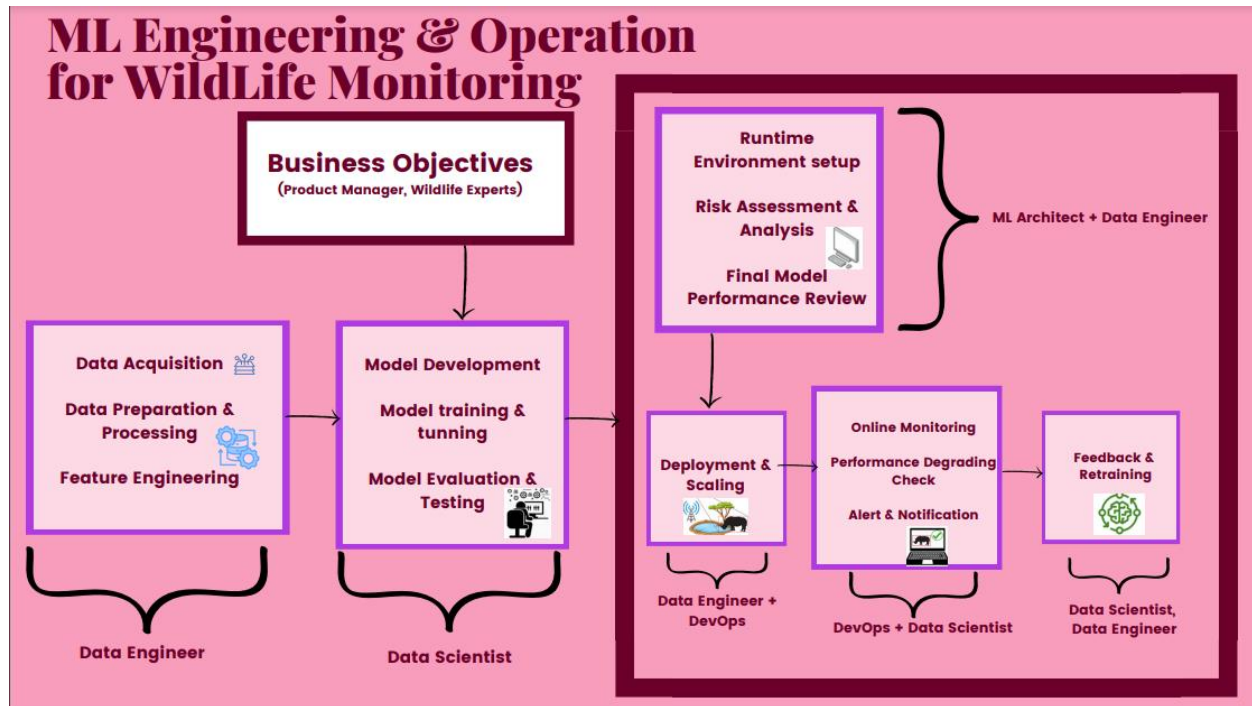
## **ARCHITECTURE DESIGN**



# FLOWCHART



## 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.

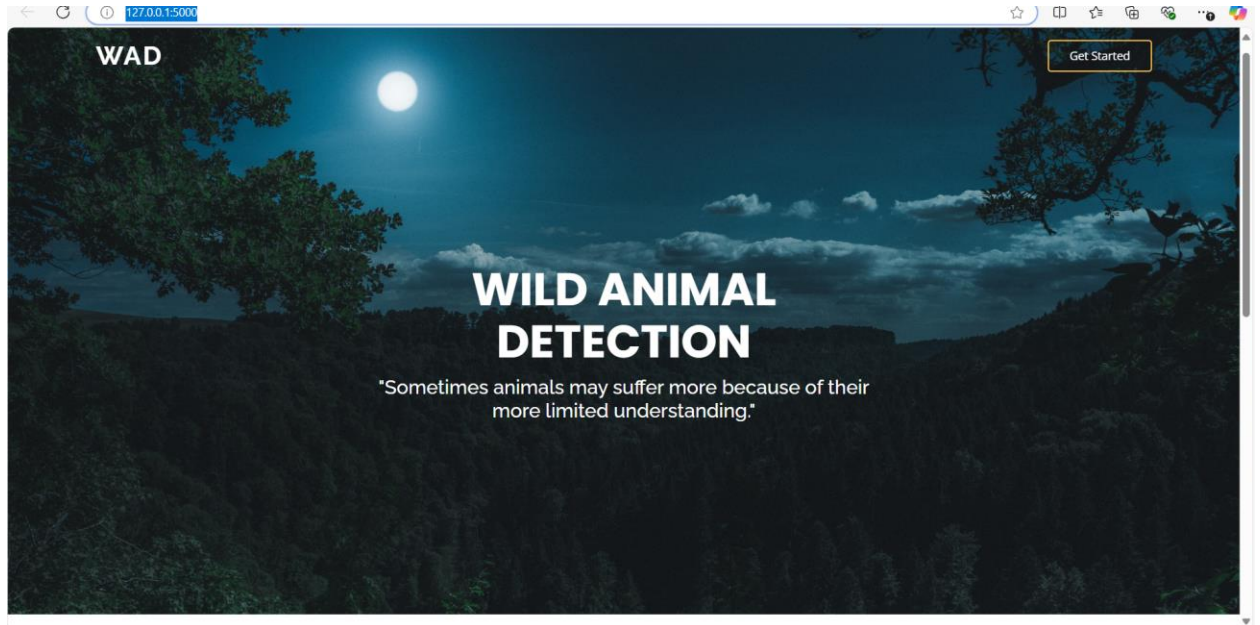
## **Dataset**

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.

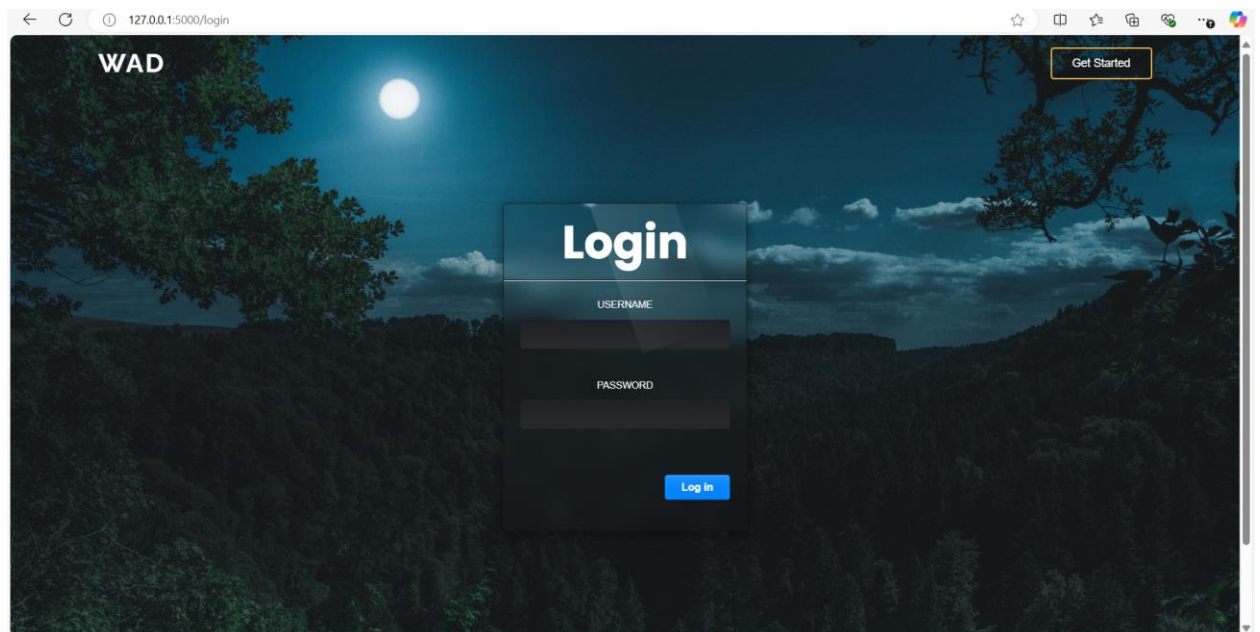
Some of our codes, such as training data, training model, and Android code, are unable to be attached to the zip file due to their excessive file size.

#### 4. Screenshot of the application:

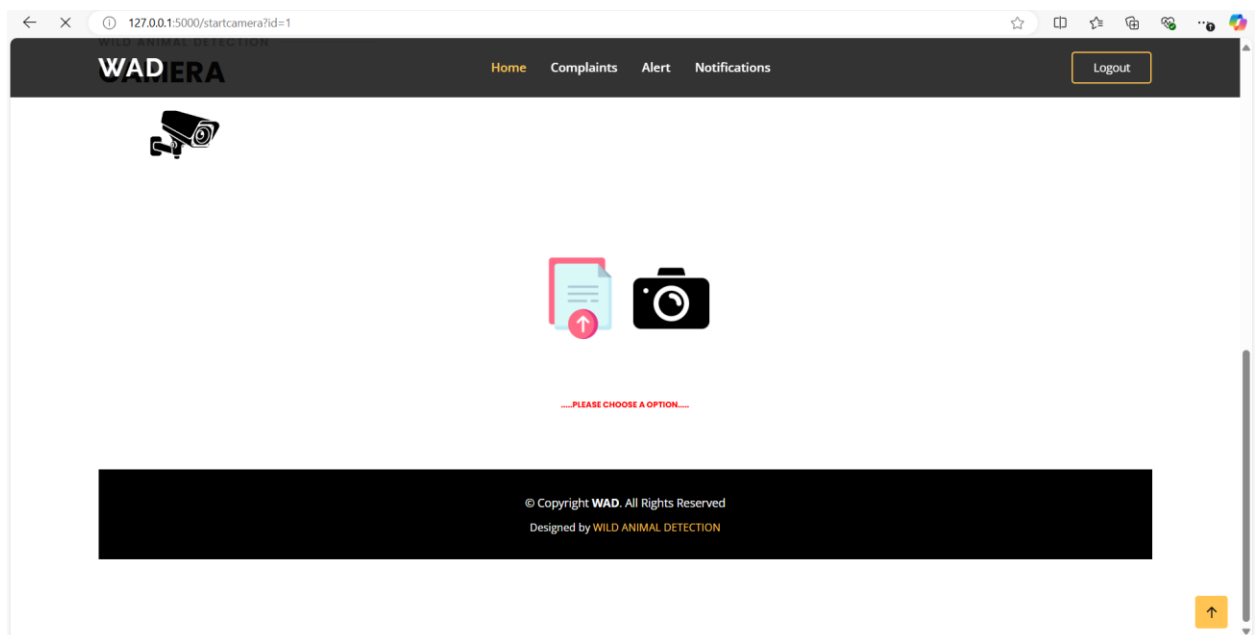
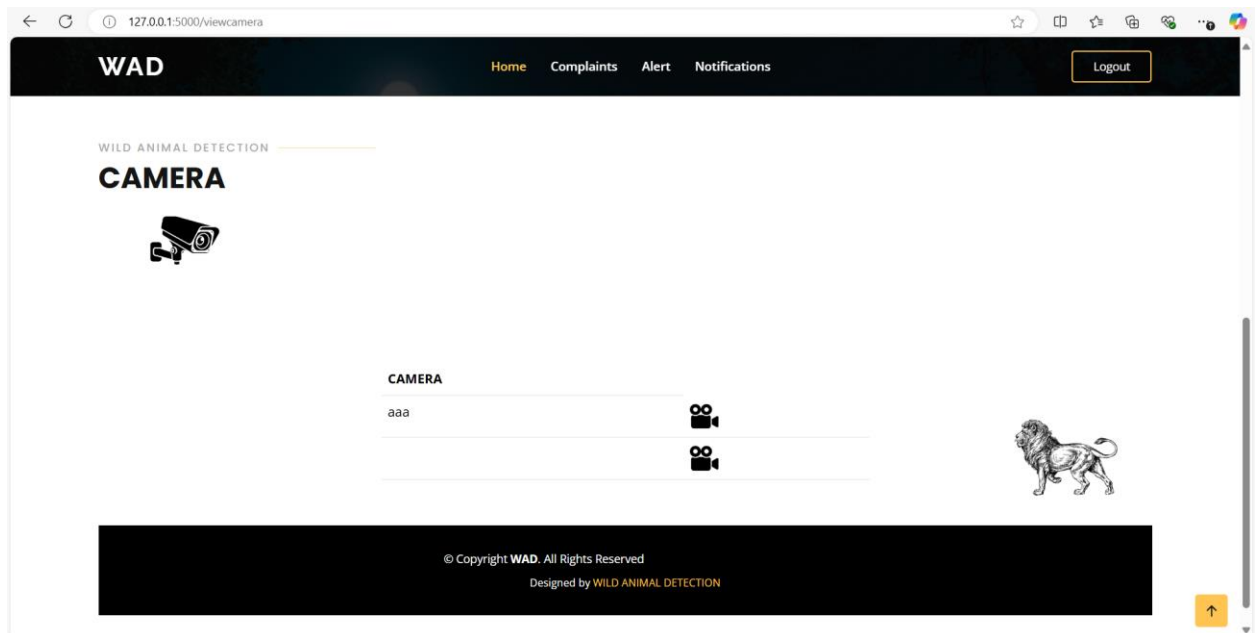
Start page:



Login page:



## Camera Functionality:



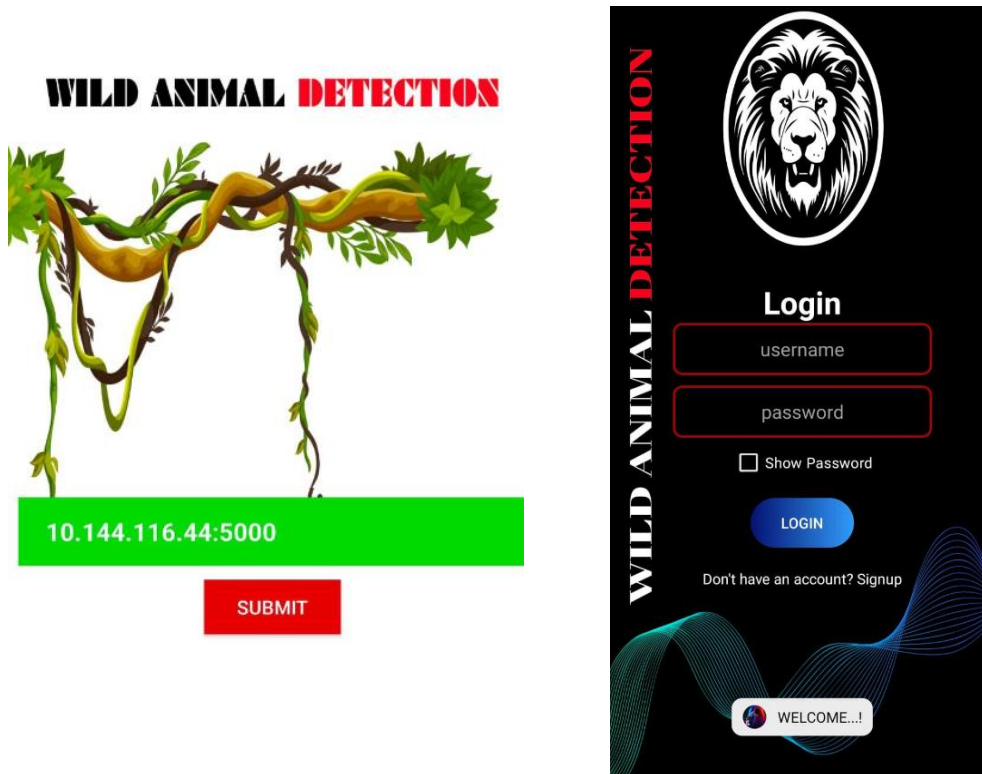


## Database:

The screenshot shows the SQLyog Community 64 interface. The 'New Connection' window is open, displaying the 'Filter tables in wild\_animal' list. The 'Tables' section is expanded, showing a list of tables including 'alert', 'allocate', 'animal', 'camera', 'complaints', 'contact\_details', 'forest\_division', 'forest\_officer', 'forest\_station', 'login', 'notifications', 'preserved\_animals', and 'user'. The 'Query 1' window is open, showing a SQL script that creates a database named 'wild\_animal' and sets various options. The 'Table Data' window is open, showing the data for the 'login' table.

login_id	username	password	usertype
1	admin	admin	admin
2	aaa	aa	officer
3	bbbb	bbbb	officer
4	fff@gmail.com	fff@gmail.com	user
5	fff@gmail.com	fff@gmail.com	user
6			user
7	ccc	ccc	user
8	aaa	aaa	user
9			user
10			officer
11	qq	qq	officer
12	vv	vv	officer
13			officer

## Android Application Screenshots:





## 5. AZURE DEVOPS BOARD:

### SPRINT 0 CLOSED:

The screenshot shows the Azure DevOps Board interface for the 'AI-AMDS Team'. The left sidebar contains navigation options: Overview, Boards, Work items, Backlogs, Sprints (selected), Queries, Delivery Plans, Pipelines, and Artifacts. The main area displays 'Sprint 0' for the period 'September 12 - October 10' (21 work days). The sprint is marked as 'Closed'. The table below lists the work items for this sprint.

Order	Title	State	Assigned To	Remarks
1	As a villager, I want to receive alerts when animals approach...	Closed	Ashwini Seelan ...	
	Install AI Cameras	Closed	Syamraj Syamraj	
	Design AI camera network architecture for national parks.	Closed	Jeremiah Onah ...	
2	As a park ranger, I want to monitor animal movements in re...	Closed	Syamraj Syamraj	
	Install AI cameras at key locations within the park.	Closed	Ashwini Seelan ...	
	Push code to Azure Repos, create pull requests for code ...	Closed	Shivam Nyati	
3	As a wildlife researcher, I need detailed reports on animal b...	Closed	Shivam Nyati	
	Implement report generation features to summarize dall...	Closed	Syamraj Syamraj	
	Set up a database to store animal movement and behavi...	Closed	Preshanth Dha...	

### SPRINT 1 CLOSED:

The screenshot shows the Azure DevOps Board interface for the 'AI-AMDS Team'. The left sidebar contains navigation options: Overview, Boards, Work items, Backlogs, Sprints (selected), Queries, Delivery Plans, Pipelines, and Artifacts. The main area displays 'Sprint 1' for the period 'October 11 - October 17' (5 work days). The sprint is marked as 'Closed'. The table below lists the work items for this sprint.

Order	Title	State	Assigned To	Remarks
1	As a villager, I want to receive alerts when animals approach...	Closed	Ashwini Seelan ...	
	Develop detection algorithms	Closed	Ashwini Seelan ...	
	Test initial detection	Closed	Jeremiah Onah ...	
2	As a park ranger, I want to monitor animal movements in re...	Closed	Syamraj Syamraj	
	Push code to Azure Repos, run CI pipeline	Closed	Preshanth Dha...	
	Develop algorithms to identify species and track movem...	Closed	Syamraj Syamraj	
3	As a wildlife researcher, I need detailed reports on animal b...	Closed	Shivam Nyati	
	Implement report generation features to summarize dall...	Closed	Ashwini Seelan ...	
	Develop analytics dashboards to visualize long-term tren...	Closed	Shivam Nyati	

## SPRINT 2 CLOSED:

Azure DevOps Snyati71210840 / AI-AMDS / Boards / Sprints

AI-AMDS

Overview

Boards

Work items

Boards

Backlogs

Sprints

Queries

Delivery Plans

Pipelines

Artifacts

Project settings

AI-AMDS Team

+ New Work Item

Column Options

Create Query

Taskboard Backlog Analytics

Sprint 2

October 18 - October 31  
10 work days

Order	Title	State	Assigned To	Rema...
1	Website for Wildlife Monitoring	Closed	Ashwini Seelan ...	
2	Integration with AI Model	Closed	Jeremiah Onah ...	
3	As a villager, I want to receive alerts when animals approach...	Closed	Ashwini Seelan ...	

## SPRINT 3 CLOSED:

Azure DevOps Snyati71210840 / AI-AMDS / Boards / Sprints

AI-AMDS

Overview

Boards

Work items

Boards

Backlogs

Sprints

Queries

Delivery Plans

Pipelines

Artifacts

Project settings

AI-AMDS Team

+ New Work Item

Column Options

Create Query

Taskboard Backlog Analytics

Sprint 3

October 28 - November 3  
5 work days

Order	Title	State	Assigned To	Rema...
1	Mobile & Web App Development	Closed	Syamraj Syamraj	
	Implement Firebase notifications for villagers (alert syste...	Closed	Jeremiah Onah ...	
	Add GPS functionality for tourists and rangers.	Closed	Ashwini Seelan ...	
	Develop an alternative route suggestion system based o...	Closed	Preshanth Dha...	
	Test the app's notification system in real-time with dum...	Closed	Shivam Nyati	
2	Advanced Model Training	Closed		
	Improve YOLOv4 with advanced training data	Closed		
	Test detection performance in various conditions	Closed		

# SPRINT 4 CLOSED:

The screenshot shows the Azure DevOps interface for the AI-AMDS Team. The left sidebar contains navigation options: Overview, Boards, Work Items, Backlogs, Sprints (selected), Queries, Delivery Plans, Pipelines, and Artifacts. The main area displays the 'Sprint 4' board, which is marked as 'Closed'. The board shows a list of work items with columns for Order, Title, State, Assigned To, and Remaining Time. The work items are as follows:

Order	Title	State	Assigned To	Remaining Time
1	Mobile & Web App Development	Closed	Syamraj Syamraj	
2	Develop an alternative route suggestion system based on...	Active	Ashwini Seelan ...	
3	Route Calculation Algorithm	New		
4	Develop an algorithm that takes detected wildlife locatio...	New	Preshanth Dha...	
5	As a developer, I want the app to seamlessly integrate dete...	New	Preshanth Dha...	
6	Train YOLOv4 on new location-specific datasets.	Active	Shivam Nyati	
7	Improve detection accuracy with diverse environmental t...	Active	Ashwini Seelan ...	
8	Integrate detection outputs with UI maps in real-time.	Active	Jeremiah Onah ...	
9	Internal Review	Active	Shivam Nyati	

# Internal Review:

The screenshot shows the details of a work item titled 'Internal Review' (ID 140) by Shivam Nyati. The work item is in the 'Active' state. The 'Description' field contains the text: 'Test the REST API endpoint for ML Use Case 1, validate the response format and error handling.' The 'Acceptance Criteria' field lists two criteria: 'Ensure that the API returns the correct JSON response for both valid and invalid data.' and 'Check that error codes and messages are correctly displayed.' The 'Discussion' field is empty. An 'Add link' dialog box is open in the center, showing the following information:

- You are adding a link from: 140 Internal Review (Updated 39m ago, Active)
- Link type: GitHub Pull Request
- You can select the GitHub artifact or paste its URL manually.
- GitHub repository: shivam8907121/Wild-Animal-Detection-
- GitHub pull request: PR 1: Internal review
- Comment: Enter a comment

The dialog box has 'Add link' and 'Cancel' buttons. The background shows the 'Deployment' and 'Development' sections of the work item.

# SPRINT 5 CLOSED:

Azure DevOps

Snyati71210840 / AI-AMDS / Boards / Sprints

AI-AMDS

Overview

Boards

Work items

Boards

Backlogs

Sprints

Queries

Delivery Plans

Pipelines

Artifacts

AI-AMDS Team

New Work Item

Column Options

Create Query

Taskboard

Backlog

Analytics

Sprint 5

November 11 - November 21

1 work day remaining

Order	Title	State	Assigned To	Rema...
1	Route Calculation Algorithm	Closed		
2	As a forest official, I want to ensure the system accurately d...	Closed	Jeremiah Onah ...	
3	As a villager, I want to confirm that I receive timely notificati...	Closed	Preshanth Dha...	
4	Refining the model and code	Closed	Syamraj Syamraj	
5	As a user, I want a dashboard that displays live animal locati...	Closed	Shivam Nyati	
6	As a system administrator, I want to view system logs for tr...	Closed	Ashwini Seelan ...	

Print settings

https://dev.azure.com/mcas.ms/Snyati71210840/AI-AMDS/\_workitems/edit/152/?McasTsId=26110&McasCtx=4

Order	Title	State	Assigned To	Remaining Work	Work Item Ty...	Activity
1	As a forest official, I want to ensure the system accuratel... Prepare UAT test cases for animal detection with exp... Conduct functional testing to validate detection accur... Simulate edge cases (e.g., rare species, environmen... Log results of UAT tests and identify discrepancies. Retest the system after refining detection algorithms.	New New New New New New	Jeremiah Onah Oto...		User Story Task Task Task Task Task	
2	As a villager, I want to confirm that I receive timely notifi... Develop test cases to validate the notification system'... Test notifications in different scenarios (e.g., varied a... Validate language settings for notifications to ensure L... Collect feedback from villagers during a UAT session.	New New New New New	Preshanth Dhanapal		User Story Task Task Task Task	
3	Refining the model and code Model improvements Code Refinements	Closed Closed Closed	Syamraj Syamraj		User Story Task Task	
4	As a user, I want a dashboard that displays live animal lo... Design the dashboard layout with maps and status in... Integrate real-time data from detection systems into t... Test the functionality of status indicators (e.g., Safe, ... Validate the accuracy of live data visualizations.	New New New New New	Shivam Nyati		User Story Task Task Task Task	
5	As a system administrator, I want to view system logs for... Develop a log viewer interface with filtering capabili... Implement real-time log updates in the UI. Test log search and filter functionality (e.g., by date, e... Ensure the logs provide detailed information for troubl...	New New New New New	Ashwini Seelan Gna...		User Story Task Task Task Task	



**Azure DevOps** Snyati71210840 / AI-AMDS / Boards / Backlogs

AI-AMDS

Overview

Boards

Work Items

Boards

Backlogs

Sprints

Queries

Delivery Plans

Analytics views

Repos

Pipelines

Test Plans

Artifacts

Project settings

AI-AMDS Team

New Work Item

View as Board

Column Options

Backlog

Analytics

Order	Work Item...	Title
1	Epic	Use Case 1: Wildlife-Human Conflict Prevention in Villages
	Feature	Feature 1: Real-Time Animal Detection
2	Epic	Use Case 2: Protected Wildlife Monitoring in National Parks
	Feature	Real-Time Animal Activity Monitoring
	Feature	Conservation Reporting System
3	Epic	Improved Detection Accuracy
	Feature	Seamless Integration with YOLOv4
4	Epic	Mobile & Web App Optimization
	Feature	Advanced Interface Design
5	Epic	Finalizing UAT for Wildlife Detection System
	Feature	Feature 1: UAT and Feedback Integration
6	Epic	Developing a User-Friendly UI for Wildlife Detection
	Feature	Feature 2: UI Design and Integration

Epics

Planning

Drag and drop work items to include them in a sprint.

AI-AMDS Team backlog

Sprint 6 18/11/2024 - 24/11/2024  
Planned Effort: 0 5 working days  
5 19

Sprint 7 25/11/2024 - 01/12/2024  
5 working days  
No work scheduled yet

Sprint 8 02/12/2024 - 08/12/2024  
5 working days  
No work scheduled yet

+ New Sprint

## SPRINT 6 CLOSED:

**Azure DevOps** Snyati71210840 / AI-AMDS / Boards / Sprints

AI-AMDS

Overview

Boards

Work Items

Boards

Backlogs

Sprints

Queries

Delivery Plans

Pipelines

Artifacts

Project settings

AI-AMDS Team

New Work Item

Column Options

Create Query

Taskboard

Backlog

Analytics

Sprint 6

November 18 - December 4  
2 work days remaining

Order	Title	State	Assigned To	Rema...
1	Project Final Report	New		
	Compile Project Documentation	Closed	Ashwini Seelan ...	
	Finalize Codebase	Closed	Syamraj Syamraj	
	Conduct Final UAT	Closed	Jeremiah Onah ...	
	Generate Data Insights	Closed	Preshanth Dha...	
2	Final Presentation Plan	New		
	Prepare the Final Report	Closed	Shivam Nyati	
	Create Presentation Slides	Closed	Ashwini Seelan ...	
	Record a System Demo	Closed	Syamraj Syamraj	
	Address Feedback	Closed	Jeremiah Onah ...	
3	Refining the model and code	Closed	Syamraj Syamraj	
	Model improvements	Closed		
	Code Refinements	Closed		

## SPRINT 7 CLOSED:

The screenshot shows the Azure DevOps interface for the AI-AMDS Team. The left sidebar contains navigation options: Overview, Boards, Work items, Backlogs, Sprints (selected), Queries, Delivery Plans, Pipelines, and Artifacts. The main area displays the 'Sprint 7' backlog. The sprint is scheduled for December 4 - December 10, lasting 7 work days. The backlog contains the following tasks:

Order	Title	State	Assigned To
1	Project Final Report	Closed	
	Compile Project Documentation	Closed	Shivam Nyati
	Finalize Codebase	Closed	Syamraj Syamraj
2	Final Presentation Plan	Closed	
	Prepare the Final Report	Closed	Ashwini Seelan ...
	Create Presentation Slides	Closed	Preshanth Dha...
	Address Feedback	Closed	Jeremiah Onah ...

## GITHUB REPOSITORY:

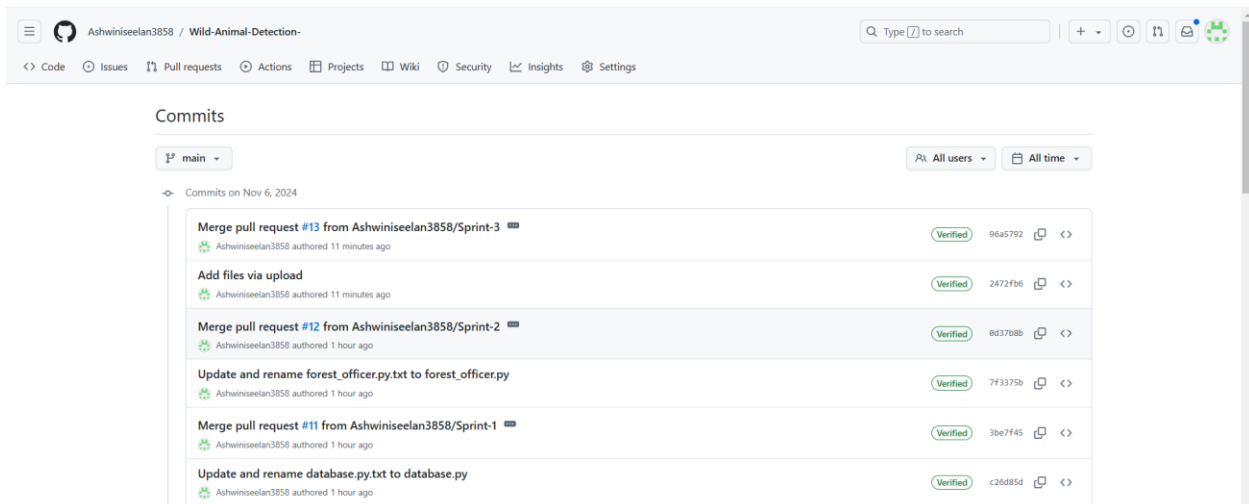
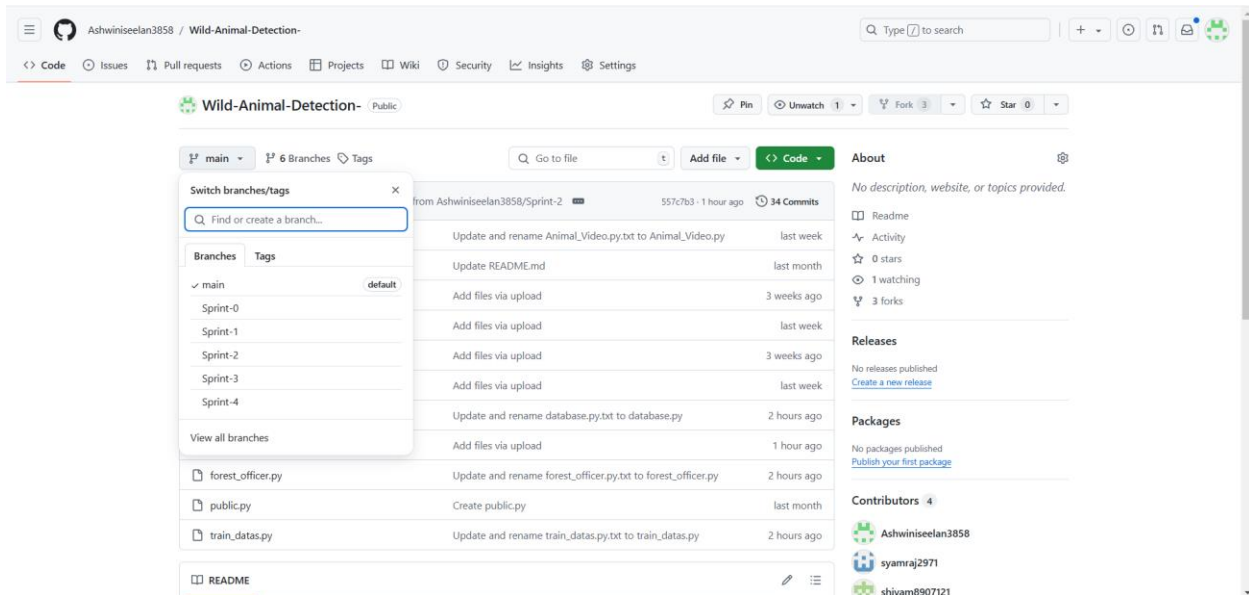
## SPRINT 3 and 4 Branch created.

The screenshot shows the GitHub repository page for 'Wild-Animal-Detection-'. The repository is public and has 5 branches. A 'Switch branches/tags' dropdown menu is open, showing the following branches:

- main (default)
- Sprint-0
- Sprint-1
- Sprint-2
- Sprint-3

The repository also shows a list of commits, including 'Update and rename Animal\_Video.py.txt to Animal\_Video.py', 'Update README.md', and 'Add files via upload'. The right sidebar contains information about the repository, including the README, activity, stars, forks, releases, packages, and contributors.





## 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.
- Kumar P. M., Gandhi U., Varatharajan R., Manogaran G., Jidhesh R., and Vadivel T., Intelligent face recognition and navigation system using neural learning for smart security in internet of things, *Cluster Computing*. (2019) 22, no. S4, 7733–7744, <https://doi.org/10.1007/s10586-017-1323-4>, 2-s2.0-85034593442.
- Babanne V., Mahajan N. S., Sharma R. L., and Gargate P. P., Machine learning based smart surveillance system, *Proceedings of the 2019 Third International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)*, December 2019, Palladam, India, IEEE, 84–86.
- Narejo, S., Pandey, B., Vargas, D. E., Rodriguez, C., & Anjum, M. R. (2021). Weapon detection using YOLO V3 for smart surveillance system. *Mathematical Problems in Engineering*, 2021, 1–9. <https://doi.org/10.1155/2021/9975700>
- Verma G. K. and Dhillon A., A handheld gun detection using faster r-cnn deep learning, *Proceedings of the 7th International Conference on Computer and Communication Technology*, November 2017, Kurukshetra, Haryana, 84–88.