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AI-BASED ANIMAL DETECTION SYSTEM FOR NIGHT ROAD SAFETY

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Abstract: Animal crossings on roads at night pose a serious risk to human safety and wildlife. This paper proposes an AI-Based Animal Detection System for Night Road Safety using YOLOv8 and computer vision techniques to detect animals in low-light conditions. The system processes image and video inputs to identify animal presence and generates audio or visual alerts to warn drivers. By enabling timely detection and response, the proposed system aims to reduce animal-vehicle collisions, improve road safety, and support wildlife protection.

Index Terms—Animal detection, night road safety, YOLOv8, deep learning, computer vision, low-light image enhancement, object detection, alert generation.

1. INTRODUCTION

Road safety is a major concern worldwide, particularly during nighttime when reduced visibility makes it difficult for drivers to identify obstacles and animals crossing roads. Animal-vehicle collisions are frequently reported on highways, rural roads, and routes passing through forest areas, where animals may unexpectedly enter the roadway in search of food, water, or shelter. These incidents can result in serious injuries, loss of human and animal lives, vehicle damage, and disturbances to wildlife populations. Traditional preventive measures, such as warning signs and road barriers, may not always provide sufficient protection because they cannot detect the immediate presence of an animal or alert drivers in real time. The problem becomes more challenging at night due to poor illumination, shadows, and limited visibility, which reduce the time available for drivers to react. Therefore, an intelligent and automated system is needed to detect animals on roads promptly and provide timely warnings to help prevent potential accidents.

The AI-Based Animal Detection System for Night Road Safety proposes a computer vision-based approach that uses artificial intelligence and deep learning techniques to detect animals under low-light conditions. The system uses the YOLOv8 (You Only Look Once, version 8) object detection model to process image and video inputs, identify the presence of animals, and mark the detected regions for better visibility. Image preprocessing techniques, including brightness adjustment, contrast enhancement, and noise reduction, can help improve the quality of input images captured in dark environments. When an animal is detected, the system generates audio or visual alerts to notify drivers and enable them to take appropriate preventive action. The proposed approach aims to support faster detection, improve nighttime road safety, reduce animal-vehicle collisions, and protect wildlife. By combining computer vision, deep learning, and an alert mechanism, the system provides a potential technological solution for safer roads and improved coexistence between humans and animal.

1.1 NEED FOR THE STUDY

Animal-vehicle collisions during nighttime are a major safety concern, particularly on highways, rural roads, and routes near forests and wildlife habitats. Poor visibility makes it difficult for drivers to identify animals crossing the road in time, increasing the risk of accidents, injuries, and loss of life. Existing preventive measures, such as warning signs and road barriers, may not always provide immediate information about the presence of animals. Therefore, there is a need for an intelligent system that can detect animals under low-light conditions and provide timely alerts to drivers. The proposed AI-Based Animal Detection System for Night Road Safety uses the YOLOv8 deep learning model and computer vision techniques to process image and video inputs, detect animals, and generate audio or visual alerts. This study aims to explore how artificial intelligence can improve driver awareness, reduce animal-vehicle collisions, enhance nighttime road safety, and contribute to wildlife protection.

1.2 PROBLEM STATEMENT

In low-light conditions, animals may be difficult to distinguish from shadows, vegetation, road edges, or other objects. Poor illumination, motion blur, partial occlusion, and low-resolution footage can reduce detection reliability. Passive measures such as signs do not provide an immediate alert about an animal currently on the road. The problem addressed in this work is the design of an automated system that analyses nighttime image or video input, detects animals using a deep-learning model, and produces timely visual or audio notifications while accounting for possible false positives and missed detection.

1.3 OBJECTIVES

- To design a YOLOv8-based approach for detecting animals in nighttime road scenes.
- To consider image enhancement techniques such as brightness adjustment, contrast improvement, and noise reduction.
- To provide an on-screen warning or sound notification when an animal is detected.
- To define an evaluation process based on detection quality, processing speed, and reliability.

• To explore how automated animal detection may support road safety and wildlife protection.

1.4 RELATED WORK

Previous work has investigated animal–vehicle collisions and approaches for helping drivers respond to animal presence [1], [3]. Deep-learning methods have also been applied to animal detection in surveillance video and thermal imagery [4], [5]. These studies indicate that object detection and specialized imaging can contribute to wildlife monitoring, although performance depends on the scene, input quality, and detection method. Work on convolutional neural networks and animal detection provides further background for applying learned visual features to this task [6]. Low-light visibility enhancement is also relevant because image quality can influence downstream detection [9]. The supplied project synopsis identifies YOLO-family models as promising because of their speed and suitability for object detection. However, a model that performs well in ordinary daylight cannot automatically be assumed to work equally well at night. The proposed study therefore emphasizes evaluation under different lighting and environmental conditions instead of assuming a particular accuracy in advance.

2. LITERATURE SURVEY

Existing research on animal detection for road and wildlife safety has explored conventional warning systems and computer-vision-based approaches. Traditional methods, such as warning signs and fencing, help reduce animal–vehicle collisions but cannot provide real-time alerts based on animal presence. Recent advances in deep learning have enabled automated animal detection in images and video streams using models such as Faster R-CNN and You Only Look Once (YOLO). However, detection performance may be affected by low illumination, occlusion, varying animal sizes, and complex environmental backgrounds.

To address these challenges, researchers have explored infrared imaging and low-light image enhancement techniques to improve animal visibility under nighttime conditions. Although these approaches offer potential benefits, reliable detection under diverse lighting and environmental conditions remains challenging. Therefore, this project proposes an integrated animal detection system that processes image or video input, identifies animals, and generates alerts to support timely responses. The proposed system aims to contribute to improved road safety and wildlife protection through automated detection and warning mechanisms.

3. PROPOSED SYSTEM AND METHODOLOGY

The proposed system uses the YOLOv8 object detection model to identify animals in nighttime road images and videos. The system consists of input acquisition, image preprocessing, animal detection, detection output, and alert generation. Input images or video frames are processed to identify animals, display bounding boxes, and generate a warning sound when an animal is detected. The proposed approach aims to support timely animal detection and improve nighttime road safety.

3.1 System Workflow

The system workflow consists of six stages: image and video collection, data labelling and preprocessing, YOLOv8 model training, model testing, real-time animal detection, and alert generation. The trained model processes input frames and identifies animal locations. Detected animals are highlighted using bounding boxes, and an alert is generated when the detection satisfies the selected confidence threshold.

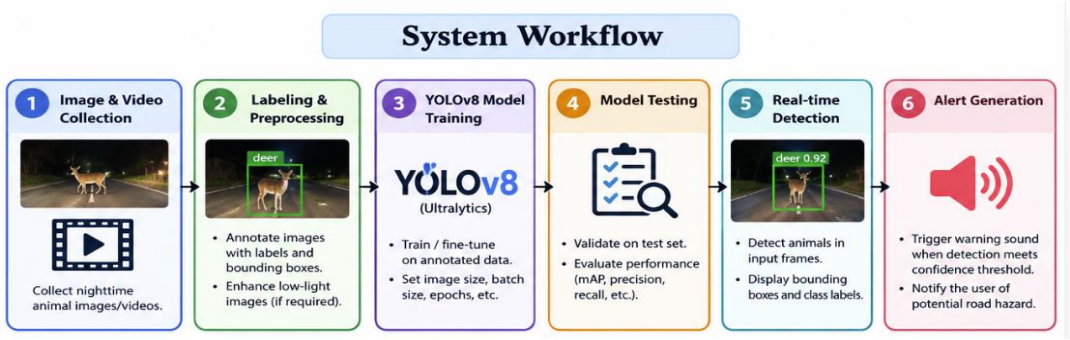

Figure 3.1: System Workflow

3.2 Dataset Preparation

Animal images and videos are collected to represent different animal categories, road environments, distances, and lighting conditions. Images used for model training are annotated with appropriate class labels and bounding boxes. The dataset is divided into training, validation, and testing subsets to facilitate model training and performance evaluation.

3.3 Image Preprocessing

The preprocessing module prepares input images and video frames for detection. Image enhancement techniques may be applied to improve visibility in low-light conditions, while video frames are extracted for processing. These operations aim to

facilitate animal detection in nighttime environments. The effectiveness of the selected preprocessing techniques should be evaluated using experimental results.

3.4 Detection and Alert Generation

The YOLOv8 model processes the input frames and predicts animal classes, bounding-box coordinates, and confidence scores. Detected animals are highlighted in the output, and the corresponding prediction information is displayed. When a detection meets the predefined confidence threshold, the alert module generates a warning sound to notify the user of a potential animal-related road hazard.

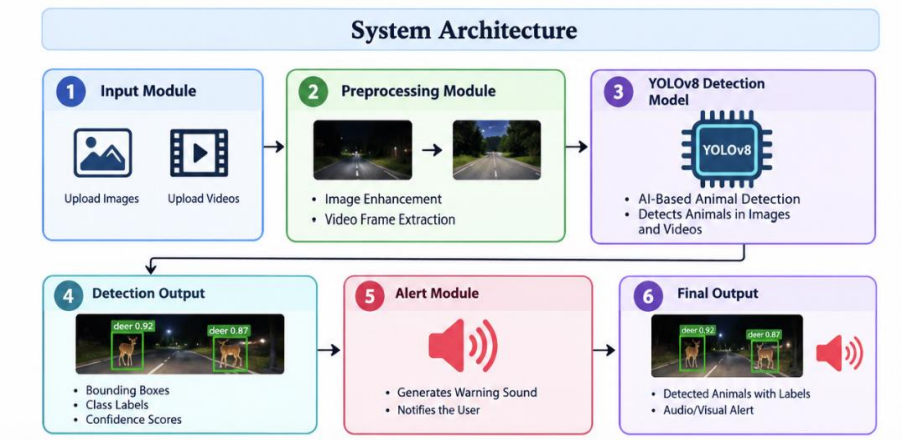

Figure 3.4: System Architecture

3.5 System Output and Evaluation

The proposed system uses YOLOv8 to detect animals in nighttime road images or video frames. Detected animals are highlighted using bounding boxes, class labels, and confidence scores. Warning alerts can be generated to notify drivers of potential animal hazards. System performance is evaluated using precision, recall, mean Average Precision (mAP), and inference time under different nighttime conditions, including low illumination and headlight glare.

S.No	Metric	Description
1	Precision	Measures the correctness of animal detections
2	Recall	Measures how many actual animals are detected.
3	mAP	Evaluates overall object detection performance.
4	Inference Time	Measures the time required to process an image or video frame.
5	Alert Generation	Checks whether a warning is triggered when an animal is detected

4. RESULTS AND DISCUSSION

The proposed AI-based animal detection system was evaluated using animal images, road-scene images, and live webcam input. The YOLOv8 model processed the inputs and displayed detected animals using bounding boxes and corresponding confidence scores. The experimental outputs demonstrate the system's ability to identify animal regions in the tested images and video stream.

4.1 QUALITATIVE RESULTS OF ANIMAL DETECTION

The study considered the detection of animals, confidence scores, bounding box localization, multiple-animal detection, and performance under different input conditions. The observed outputs showed that the system could detect animals in selected dataset images and display confidence scores for individual detections. The displayed confidence scores included 76.15% and 28.04%, indicating different confidence levels for the corresponding predictions. The system also demonstrated multiple-animal detection in a road scene and detection through live webcam input. An additional night-time image can be used to examine the system's performance under low-light conditions, provided that the image was actually tested using the implemented system. These observations provide qualitative evidence of the system's detection capability.

However, the confidence scores of individual detections do not represent the overall accuracy of the model. Quantitative evaluation using a labelled test dataset is necessary to calculate performance measures such as precision, recall, mean Average Precision (mAP), and processing speed.

4.2 Animal Detection on Dataset Images and Real-Time Webcam Input

The proposed YOLOv8-based animal detection system was tested using selected animal dataset images and live webcam video input. For dataset images, the model detected animal regions and displayed bounding boxes with corresponding confidence scores. The system was also tested with live webcam input, where incoming video frames were processed to detect animals in real time. These results demonstrate the system's ability to perform animal detection on static images and live video input. However, further testing under different environmental and lighting conditions is required to evaluate the overall reliability and performance of the system.

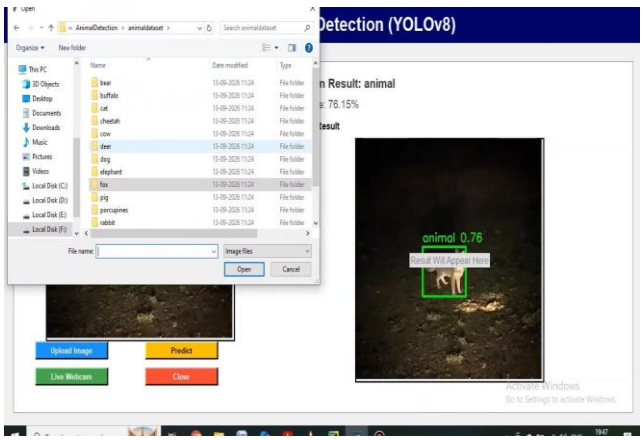

Figure 1: Animal dete confidence score of 76.15%.

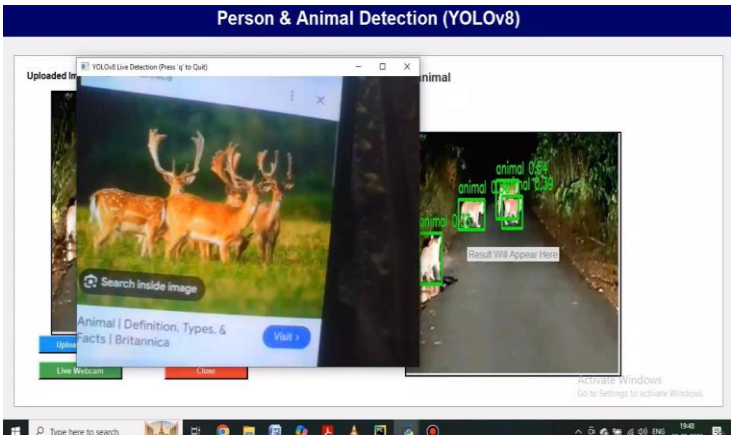

Figure 2: Real-time animal detection using live webcam video input

4.3 Animal Detection on Road Images and Under Night-Time Conditions

The proposed YOLOv8-based animal detection system was evaluated using road images and night-time images to examine its animal detection capability under different visual conditions. The model displayed bounding boxes around detected animal regions along with corresponding confidence scores. In one observed road-image example, the displayed confidence score was 28.04%. Night-time image testing can help assess the model's response to reduced illumination. These observations provide examples of the system's detection output; however, further testing using a labelled dataset containing diverse road scenes and lighting conditions is required to evaluate overall performance and reliability.

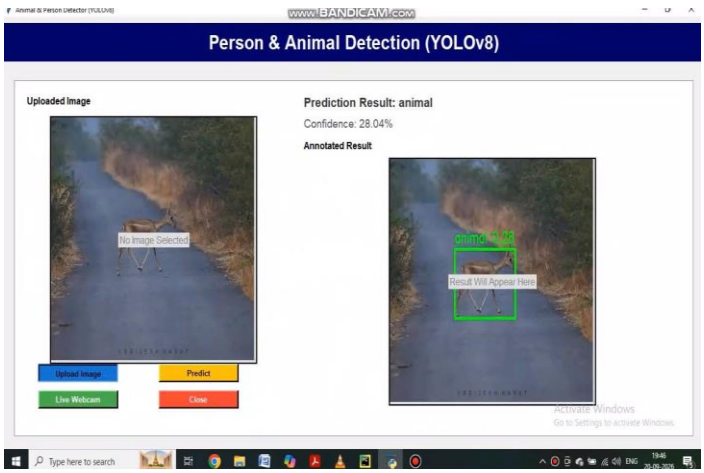

Figure 3: Animal detection in a road image with a confidence score of 28.04%.

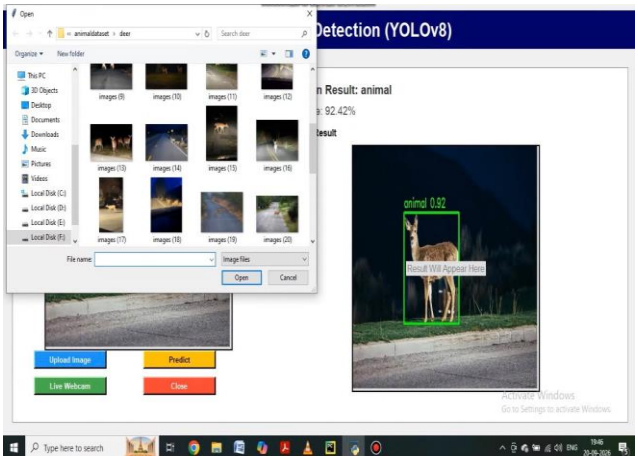

Figure 4: Animal detection under night-time conditions using the proposed YOLOv8 system

5. CONCLUSION

The proposed AI-Based Animal Detection System for Night Road Safety aims to improve road safety by detecting animals in images and videos, particularly under low-light conditions. The system uses deep learning and computer vision techniques to identify animals and mark their locations in the input. An alert mechanism can help notify users when an animal is detected, potentially reducing the risk of animal–vehicle collisions. The effectiveness of the system depends on factors such as image quality, lighting conditions, and the detection model's performance. Further improvements can focus on enhancing detection in very dark

environments, reducing false detections, and evaluating the system using a larger and more diverse dataset. Overall, the proposed system has the potential to support safer night-time driving and protect both humans and animals.

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