IJARCCE

ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⪤ Peer-reviewed & Refereed journal ⪤ Vol. 15, Issue 6, June 2026

DOI: 10.17148/IJARCCE.2026.15696

Predictive Wildlife Collision Prevention using Deep Learning

Deepthi V[1], Priyanka Kumar Teradale[2], S M Varsha[3]

Students, Department of MCA, SJB Institute of Technology, Bangalore, India[1-3]

Abstract: Animal vehicle collisions are a big problem on highways and forest roads people get hurt animals die and cars end up damaged. Most current systems just spot animals and throw out basic alerts but they do not actually think ahead about where the animal might go or how likely a crash is. That is where this paper steps in. We Introduce Preventing and Predictive Wildlife Collision using Deep Learning a smarter framework focused on stopping accidents before they even happen. Here is how it works means we use YOLOv8 to spot animals and DeepSORT to keep track of where they are moving and LSTM to predict what they will do next especially if they might try to cross the road. The system looks at movement patterns and figures out how risky a potential collision is and quickly sends warning alerts to nearby cars using MQTT based communication by mixing animal detection future prediction and smart alerts and our approach brings better safety to the road and actually tackles the problem of animal vehicle collisions heads on.

1. INTRODUCTION

1.1 Background of the Study

Road transportation keeps our world moving but lately more run ins between cars and animals are putting people at risk. You see it everywhere on highways quiet forest roads and out in the country side animals dart out and drivers barely have time to react. These crashes hurt people and wreck vehicles and kill wildlife and end up costing a lot of money. Artificial Intelligence Deep Learning and Computer Vision are moving fast and they are really changing how we handle road safety. Recent developments have made transportation systems smarter but when it comes to wildlife monitoring setups it just spots animals and flash a warning. The big problem They stop there they do not try to predict where those animals might go next or figure out if there is a real risk of a crash before anything actually happens.

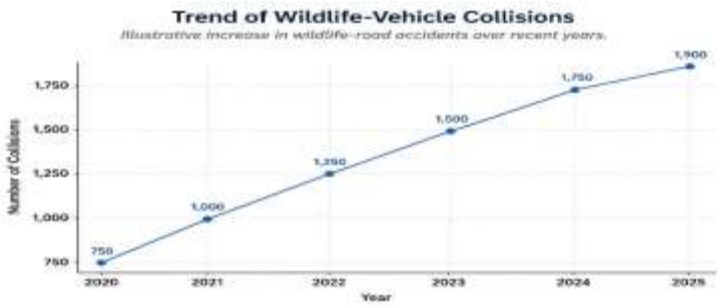

Fig. 1. Increasing Trend of Wildlife-Vehicle Collisions

Predictive tech has opened the door to smarter accident prevention. When you pull together in real time detection and object tracking and trajectory prediction and smart alerts you create a system that gives early warnings meaning fewer collisions and safer outcomes for everyone. This research introduces a smart system for predicting and preventing wildlife collisions. It uses YOLOv8 to spot animals and DeepSORT to track where they move and LSTM networks to guess where they are headed next. On top of that the system analyses animal behaviour and sends out smart alerts to keep roads safer and cut down on accidents involving wildlife.

1.2 Problem Statement

Most wildlife collision prevention systems just spot animals and send out basic alerts. The problem They do not try to predict where animals will go understand their behaviour or figure out the real risk in real time. That means drivers often only get warned once an animal is already in their path and accidents are hard to avoid.

1.3 Objectives of the Study

Spot animals fast and accurately in real time on the road. Track their movements as they go using object tracking. Predict where animals are headed and how they will behave around the road. Watch for any strange movements that could mean a higher risk of collision. Send smart warnings to vehicles nearby when there is danger. Make roads safer and cut down on animal vehicle collisions with these predictions.

1.4 Scope of the Study

This study investigates the application of Deep Learning and Computer Vision techniques for reducing wildlife related road accidents. We are talking about spotting animals in real time tracking where they go predicting their paths and making sense of their behaviour. On top of that the system sends alerts to smart vehicles so drivers know what is happening. You can use it on highways and forest roads and rural routes and also pretty much anywhere with intelligent transportation. The goal is Making roads safer and cutting down on accidents involving wildlife.

2.LITERATURE REVIEW

Researchers have tried a bunch of ways to cut down on wildlife vehicle collisions using Computer Vision and Deep Learning. Most of these systems center on spotting animals following their movements and alerting drivers. One team put together a deep learning based detection system to identify animals near roads. It worked well for picking out creatures but it could only spot them it did not give any insight into where they might go next.

Earlier studies used Mask R CNN to spot animals in road surveillance videos. These systems improved how well the animals were recognized but there was still a gap they did not offer real time predictions or actually assess the risk of collisions intelligently. Newer research brought in object tracking so we can follow animals as they move frame by frame. Tracking gives a clearer picture of how animals move but most systems stop there. They do not predict where animals are going next or analyse what they will do right before a collision.

A bunch of IoT warning systems have popped up to alert drivers when animals show up close to the road. But most of them stick to simple rules and only send out alerts once the animal actually steps on to the road. Looking at the research out there most systems just cover detection and basic alerts. Hardly anyone is combining things like animal detection and movement tracking and also predicting where the animal is headed analysing its behaviour and sending smart alerts all in one place. That is where this project comes in. It is an AI driven wildlife collision prevention system that ties together YOLOv8, DeepSORT, LSTM, and MQTT communication. The main goal of this system is to provide drivers with an early warning about animal entering the road and make roads safer for everyone.

3.METHODOLOGY

3.1 Overview of Proposed System

This research paper is titled as Predictive Wildlife Collision Prevention using Deep Learning and it takes a fresh approach to cutting down on animal and vehicle collisions. Instead of stopping at just spotting animals it uses Computer Vision and Deep Learning and IoT to forecast where animals might go next. That way drivers get an early heads up before a collision is even likely. It works by tying together several pieces real time animal detection and tracking their movements and also predicting their paths analysing behaviour and the estimating collision risk and then sending smart alerts to vehicles nearby. All these elements team up to make roads safer for both people and wildlife. Plus with this system drivers get a heads up early enough to actually do something about it so there are fewer accidents and less damage whether it's to cars or animals.

3.2 Technologies used

The proposed system employs several advanced technologies to perform different tasks efficiently

1. YOLOv8 for real-time animal detection.
2.DeepSORT is used in tracking animals movement across video frames.
3. LSTM (Long Short-Term Memory) for predicting future trajectories and road crossing behaviour.
4. OpenCV for video processing and image analysis.
5. MQTT (Message Queuing Telemetry Transport) for transmitting warning alerts to nearby vehicles.
6. Flask/Streamlit for monitoring and visualization through a dashboard.

3.3 Proposed System Architecture

The system grabs video from cameras either on the roadside or mounted on vehicles. It runs those frames through YOLOv8 which spots any animals wandering around. DeepSORT keeps track of each animal and following their movements and logging where they go. After that it hands over the trajectory data to an LSTM network which predicts where those animals are headed next and the chances they will cross the road. Whenever the system spots risky behaviour or movement patterns it figures out the chance of a collision and pushes out warning alerts. Those alerts go directly to

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁐ Peer-reviewed & Refereed journal ⁐ Vol. 15, Issue 6, June 2026

DOI: 10.17148/IJARCCE.2026.15696

nearby vehicles using MQTT. Then there is a dashboard that shows all the live detections and predictions and also what the risk is right now.

Fig. 3. Proposed Predictive Wildlife Collision Prevention Architecture

3.4 Working of Proposed System

First the system grabs video frames from cameras set up on roads or inside vehicles. Then it hands off the animal's movement history to an LSTM model which predicts where the animal is heading. As all this happens the system watches for sudden moves or weird behaviour that could mean trouble. If things look risky and it calculates a collision risk score in real time and fires off warnings to vehicles nearby. Drivers get a heads up with enough time to react and avoid any accidents before they happen.

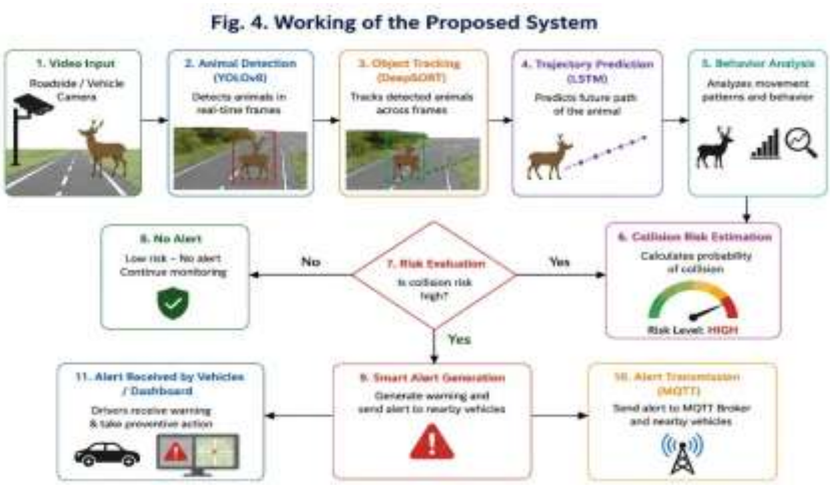

Fig. 4. Working Flow of the Proposed Wildlife Collision Prevention System

4. DATASET DESCRIPTION

4.1 Dataset Used

How well our wildlife collision prevention system works really comes down to the datasets we use for training and testing. That means we need several sets of data to each one supporting a different part of the system. For detecting animals we turn to widely available image collections. Think of the COCO Dataset, Open Images, Roboflow and some animal-specific datasets from Kaggle. These offer labeled photos of all sorts of creatures you had usually spot near roads or in the woods. These images give our system the variety it needs to recognize animals when it matters most.

The study mainly focuses on animals that are frequently involved in road accidents including Deer, Cow, Elephant, Buffalo.Besides image datasets researchers rely on custom road video collections to study how animals move and behave. By pulling movement data from these videos they can track trajectories and feed that information into LSTM networks for prediction. Mixing public data with their own video footage makes the system stronger and more relevant in real world situations.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⪻ Peer-reviewed & Refereed journal ⪻ Vol. 15, Issue 6, June 2026

DOI: 10.17148/IJARCCE.2026.15696

4.2 Dataset Size

The proposed framework uses different types of datasets for detection and tracking and also prediction tasks. The approximate dataset size used in this study is summarized in Table 1.

Table 1. Dataset Size Used in the Proposed System.

Dataset Type	Approximate Size
Animal Image Dataset	5000–7000 images
Road Video Dataset	50–100 videos
Trajectory Dataset	5000+ movement

The image dataset trains the YOLOv8 model. The video dataset helps with object tracking and behavior analysis. The trajectory sequences generated from tracked animal movements are used to train the LSTM prediction model.

4.3 Data Preprocessing

Data preprocessing is an important step to improve model accuracy and ensure efficient learning. Before training the models the collected data undergoes several preprocessing operations.

- Image Resizing:
  First all images get resized to a fixed resolution. This keeps everything consistent during training and speeds things up.
- Annotation:
  We use bounding boxes to mark out different animal classes. With these annotations the YOLOv8 model learns where each animal is in the image and what kind it is.
- Frame Extraction:
  Videos have been split into separate frames. This makes it easier to detect and track animals across consecutive images.
- Noise Removal:
  We get rid of anything that lowers quality distorted, blurry or low res images so the dataset stays clean and the model performs better.
- Normalization:
  Pixel values are scaled to a standard range which helps the model learn faster and predict more accurately.
  Once everything is prepared these datasets go straight into animal detection and movement tracking and trajectory prediction and also collision risk estimation in our proposed framework.

5. SOFTWARE TOOLS AND LIBRARIES

5.1 Development Environment

The whole setup runs on Python mostly because it is got great libraries for deep learning image work and anything you need to do fast. Each piece handles a different job detecting objects and tracking them to predicting what happens next and sending alerts when needed.

Programming Language : Python
Operating System : Windows or Linux
Deep Learning Framework : PyTorch and TensorFlow or Keras
Computer Vision Library : OpenCV
Dashboard Framework : Flask or Streamlit
Communication Protocol : MQTT
Hardware Platform : Raspberry Pi or Jetson Nano

5.2 Libraries Used

OpenCV : Used for video processing and image analysis.
NumPy : Used for numerical computations and coordinate calculations.
Pandas : Used for data storage and analysis.
Ultralytics YOLOv8 : Used for real time animal detection.
PyTorch: Used to provide deep learning support for the YOLOv8 model.
DeepSORT: is used in tracking animals movement across the frames.
TensorFlow or Keras : Used for implementing the LSTM model for trajectory prediction.
Paho MQTT : Is used in transmitting real time warning alerts to nearby vehicles.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁝ Peer-reviewed & Refereed journal ⁝ Vol. 15, Issue 6, June 2026

DOI: 10.17148/IJARCCE.2026.15696

Matplotlib :Used for visualization and performance analysis.
Flask or Streamlit : Used for developing the monitoring dashboard.

6. EXPECTED RESULTS DISCUSSION

This new wildlife collision prevention system is designed to make roads safer. It uses smart tech like computer vision and deep learning and IoT to spot animals near the road in real time. It does not just see them it tracks where they are moving and guesses where they are headed and sends out warnings before a crash can happen.
By combining YOLOv8, DeepSORT and LSTM models the system nails detection and prediction. Drivers get alerts early so they have time to react and avoid dangerous encounters with wildlife.

6.1 Expected Outputs

Real time animal detection from road video streams.
Continuous tracking of animal movement across consecutive frames.
Prediction of future animal paths and road crossing behavior.
Dynamic collision risk estimation based on movement patterns.
Real time warning alerts for nearby vehicles through MQTT communication.

6.2 Expected Benefits

Fewer animal vehicle collision incidents.
Improved driver awareness through early warning systems.
Protection of wildlife and lower animal mortality.
Better road safety on highways, forest roads and rural areas.
Support for smart transportation and road infrastructure.

7. ADVANTAGES

1) The system can spot animals and track them as they move all in real time.
2) It does not just watch it analyses behaviour picking out risky situations automatically.

8. APPLICATIONS

Highways and express ways : where animal accidents are common.
Forest roads and wildlife corridors : especially important for endangered species.
Rural and village roads : since stray animals tend to wander onto them.
Intelligent transportation setups : making traffic safer.

9. FUTURE SCOPE

There is a lot of room to make this wildlife collision prevention system even better by adding things like Vehicle to Vehicle communication and edge devices that process data right on the spot or smarter Deep Learning models. Down the line we could even predict the behaviour of more than one animal at a time and we can use drones to monitor areas or connect the system directly with self driving cars. All these upgrades boost accuracy make roads safer and help protect wildlife more effectively especially as the system grows.

10. CONCLUSION

Animal and vehicle crashes are still a big problem for both drivers and wildlife. In this research introduced a smart system called Predictive Wildlife Collision Prevention using Deep Learning. It mixes computer vision and deep learning and IoT so it can spot dangerous situations before they happen. The setup uses YOLOv8 to find animals and the DeepSORT to track where they are going LSTM to guess their movement and MQTT to send out alerts. By bringing together detection, prediction and quick warnings this system helps cut down on accidents involving animals to keeps drivers on their toes and pushes us closer to safer and smarter roads.

REFERENCES

[1]. G. Jocher et al YOLOv8 : Ultralytics Object Detection Model Ultralytics 2023. https://github.com/ultralytics/ultralytics

ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⪰ Peer-reviewed & Refereed journal ⪰ Vol. 15, Issue 6, June 2026

DOI: 10.17148/IJARCCE.2026.15696

[2]. N. Wojke, A. Bewley, and D. Paulus, "Simple Online and Realtime Tracking with a Deep Association Metric," IEEE International Conference on Image Processing (ICIP), 2017. https://arxiv.org/abs/1703.07402

[3]. G. Bradski, "The OpenCV Library," Dr. Dobb's Journal of Software Tools, 2000. https://opencv.org/

[4]. A. Banks and R. Gupta, "MQTT Version 3.1.1," OASIS Standard, 2014. https://docs.oasis-open.org/mqtt/mqtt/v3.1.1/

[5]. A. Paszke et al., "PyTorch: An Imperative Style, High-Performance Deep Learning Library," Advances in Neural Information Processing Systems (NeurIPS), 2019. https://papers.neurips.cc/paper/9015-pytorch-an-imperative-style-high-performance-deep-learning-library.pdf

[6]. S. Gupta, D. Chand, and I. Kavati, "Computer Vision based Animal Collision Avoidance Framework for Autonomous Vehicles," arXiv preprint arXiv:2012.10878, 2020. https://arxiv.org/abs/2012.10878

[7]. F. Chollet et al., "Keras: Deep Learning for Humans," GitHub Repository, 2015. https://keras.io/

