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Wild Animal Protection from Train Accident using AI and IoT

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Abstract: *The proliferation of transportation modes has led to the construction of numerous road networks, railways, and even waterways worldwide. This phenomenon has resulted in the placement of railway tracks in forest areas, potentially compromising the physical and mental health of wild animals. In India, states such as Assam, where elephants are more prevalent, have suffered greatly due to accidents on train tracks. Accidents claim the lives of hundreds of elephants, cause serious injuries to thousands, and leave them ill for the rest of their lives. This is primarily due to the inability of animals to judge the linear motion of a train, as well as the presence of dense forest trails with extreme turns that obscure the view of the moving train from a long distance. This question has remained unanswered for a long time, as the railway and forest departments have been powerless to prevent these animals from dying due to human intervention in their natural habitats. To save wild animals from train accidents in dense jungles, the proposed system designs an artificial intelligence model using deep learning to identify the wild animals from a long distance and alert the train driver. The designed model utilizes a faster RCNN to detect the wild animals that come in front of the train on tracks from long distances and then guide the IOT model to slow down the train by alarming the loco pilot in a simulated environment.*

Keywords: Accidents claim, forest departments, artificial intelligence model, deep learning, Faster RCNN and IOT model

I. INTRODUCTION

Although there is a great diversity of wildlife in India, animal deaths have increased as a result of growing human activity, particularly near railroad tracks. Conservation officials are now quite concerned about train crashes with wild animals, especially in forest areas and wildlife corridors. In addition to causing rail service disruptions and endangering passenger safety, these accidents result in the extinction of endangered animals. Animal mortality have increased due to increased human activity, especially near railroad tracks, despite India's rich natural diversity. Train collisions with wild animals are now a major worry for conservation officials, particularly in forest regions and wildlife corridors. These incidents not only impede rail operations and jeopardize passenger safety, but they also lead to the extinction of endangered animals.

PROBLEM STATEMENT

To detect the wild animal on the train tracks from long distance and alert the loco pilot for the same and slow down the train speed using the Deep learning model Faster R CNN and IOT model.

II. LITERATURE SURVEY

[1] H. Alawad et al. propose the use of machine learning (ML) techniques to enhance safety in the railway industry, particularly at railway stations. The study demonstrates that supervised ML algorithms, especially Decision Trees (DTs), provide accurate and interpretable results when analyzing accident data. Although other classifiers may offer strong performance, DTs are favored for their clarity in presenting accident details. The authors applied ML models to a

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small dataset and achieved good prediction accuracy, proving the potential of ML in this domain. They highlight the importance of larger datasets and automated data collection systems for real-time safety analysis. The study concludes that integrating ML with existing railway systems can significantly improve safety, but further in-depth technical research and data integration are essential for practical deployment.

[2] Kim, J. et al. proposed a method to detect a vehicle driving ahead in a tunnel environment. In the proposed scheme, a vehicle detector was created using a YOLO v2 learner. The learning was performed on road images acquired in various tunnel environments to generate the detector. To increase the accuracy of vehicle detection in a tunnel environment, vehicle detection performance was improved by applying the noise reduction and illuminance smoothing steps to the tunnel image in advance. In addition, according to the application of several deep learning learners, the YOLO v2 network was effective for vehicle detection in a tunnel environment. However, it was challenging to detect vehicles at the entrance and exit of the tunnel owing to the sudden change in brightness. author intend to continue with studies on vehicle detection using Kalman filters, estimation of the distance between vehicles in the tunnel, and discrimination of brake application through the detection of brake lights.

[3] M.Sowmya et al. propose an effective animal identification algorithm there are additional issues to be considered to extend. In this paper, Review of novel techniques had been utilized for animal detection and distinct applications of animals are discussed. CNN classifies animals accurately with a magnificent scope of precision and furthermore the image of the identified animal is shown for a higher outcome so it might be utilized for different purposes which incorporate identifying wild animals moving into human living space and to forestall widely varied vegetation poaching or even human animal conflict. Several methods and algorithms are used in animal detection such as Detection and monitoring algorithm using KLT, HOOF, SVM, KNN, Prototype Matching CNN, YOLO as Convolution neural network is a powerful machine learning tool that is trained to concentrate on CNN using a wide set of diverse images as it achieves the best precision in detecting animal actions

[4] Aishwarya N Kamathet al. propose the Night-Time animal detection system is the initial stage for detecting the animals and alarming drivers to take necessary actions when suddenly animal arrives in front of vehicles during night time. Our system detects the animal in and around 20 meters of the vehicle. Later this can be developed by sending an audio signal through buzzer to driver. As there is no requirement of the system when the vehicle is not in motion, authorhave implemented motion detectors to make sure the system is only working when the vehicle is moving. As our system can detect animal which is at a certain distance which is not clearly visible, this prevents hazardous animal vehicle collisions which happens at night time

III. METHODOLOGY

The suggested system's implementation entails a number of hardware and software elements cooperating to identify, assess, and address possible wildlife hazards on or close to railroad tracks. The following phases comprise the methodology:

Monitoring Cameras and Taking Pictures

Installing high-definition monitoring cameras along railroad tracks, particularly in areas that are sensitive to wildlife and forests, is the first step in the system. These cameras are in charge of continuously recording still photos or video of the environment, guaranteeing continuous observation without the need for human assistance.

Artificial Intelligence (AI) for Animal Detection

An AI-based object detection method is used to process the recorded video. We use YOLOv5 (You Only Look Once, Version 5), a real-time object identification model renowned for its accuracy and speed, for this purpose. Large datasets are used to pre-train YOLOv5, and it is further refined using datasets that feature pictures of wild creatures that are frequently seen close to railroad tracks.

To minimize false positives, the model determines the size and kind of the animal when it is identified, differentiating between real animals and innocuous objects (such as people, shrubs, and shadows). A Raspberry Pi board or other edge computing device does this detection on-site, so there's no need for continuous internet connectivity.

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Microcontroller-Based Integration and Control

The central processing unit of the system is the Raspberry Pi microcontroller. Between the camera (input) and the alarm system (output), it serves as a link. Following AI-based detection of an animal, the Raspberry Pi initiates a reaction protocol that involves informing communication modules and turning on alert systems on the ground.

IoT-Based Alert System

The technology immediately notifies the closest rail station or the incoming train of the presence of a wild animal. Depending on the network infrastructure that is available in the area, either GSM (Global System for Mobile Communication) or LoRa (Long Range) modules are used to do this. Train operators can take prompt action, like slowing down or stopping the train, thanks to this communication, which guarantees that they are informed of the possible risk ahead.

The system may be able to avert the accident before the train even reaches the scene by using remote communication in conjunction with on-site deterrents like buzzers, flashing LED lights, or speakers that make noises to frighten the animals away from the tracks.

Cloud Storage and Monitoring

Every event is captured and sent to a cloud-based database for additional analysis, including time stamps, alerts sent, and animal detections. Researchers, railroad authorities, and forest officials can access this data through a web-based dashboard that offers historical logs, real-time status updates, and analytics to enhance future planning and monitoring.

Power Supply System

A dependable power source is essential because these devices are frequently placed in isolated and wooded locations. The entire structure is powered by solar panels with battery backup systems to assure continuous operation around-the-clock, making it environmentally friendly and self-sustaining even in places without access to energy.

IV. MODELING AND ANALYSIS

Activity Diagram

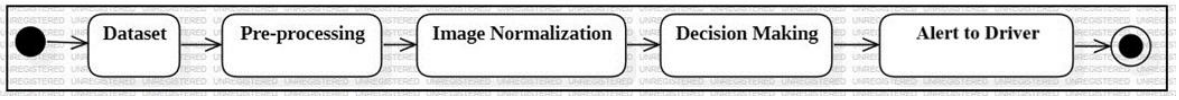

Fig 1 Activity Diagram

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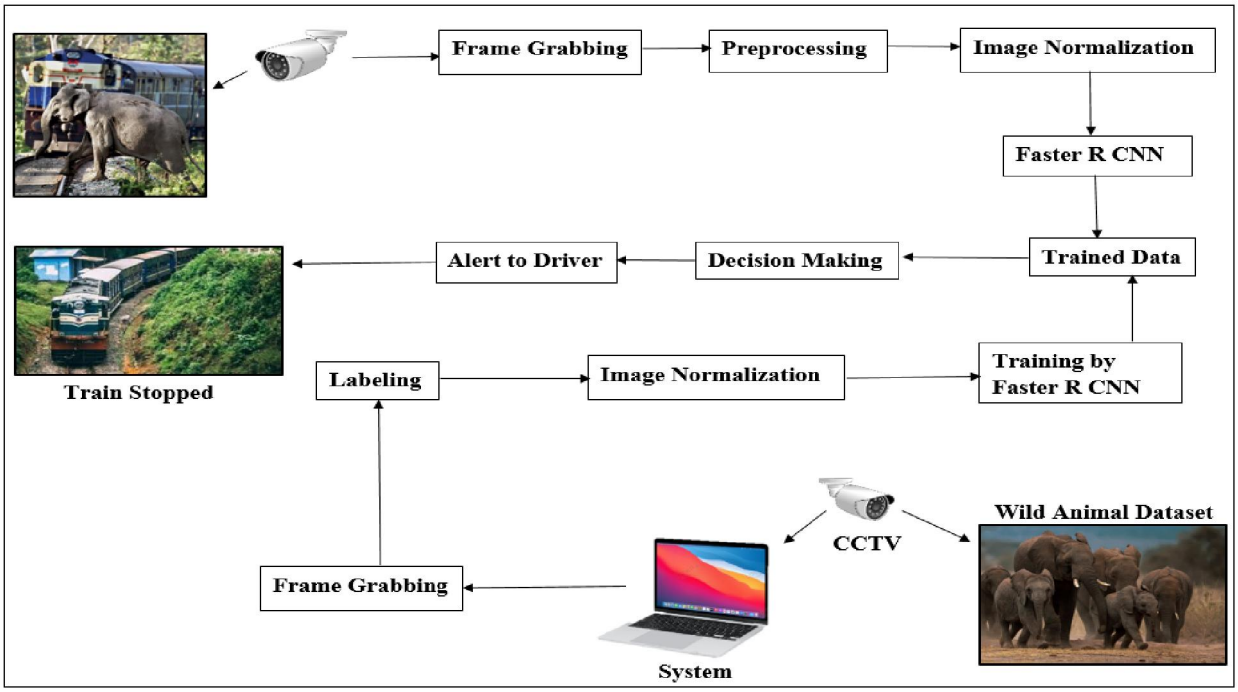
Working And Process Diagram

Powering the System



The entire setup is powered using a solar panel. This makes the system eco-friendly and suitable for remote or forested areas where traditional power sources might not be available. The solar panel provides energy to the components such as the Raspberry Pi, camera module, buzzer, and GSM module.

Capturing Images

A Pi camera (connected to the Raspberry Pi) is continuously monitoring the area around the railway track. It captures real-time video or images of the environment, scanning for any movement or presence of animals.

Animal Detection Using AI

The captured images are fed into the YOLOv5 (You Only Look Once Version 5) object detection model. This is a deep learning algorithm trained to recognize various wild animals (like elephants, deer, etc.).

If the system detects a wild animal in the frame, it triggers the next stage**.**

If no animal is detected, the system continues scanning silently in the background**.**

Triggering Alerts

When an animal is detected:

A **buzzer** is activated immediately to create noise that might scare the animal away from the tracks.

A **red LED light** starts flashing to warn any nearby railway personnel or even the animal itself.

At the same time, a **GSM module** sends a **text message or signal** to the nearest railway station or to the approaching train's control center, notifying them about the presence of an animal on or near the track.

Dataset

In the future, this system can be improved to save information like the date, time, photo, and location whenever an animal is detected. This data can be stored in the cloud so that railway and forest officers can track patterns, identify risky areas, and make better safety plans.

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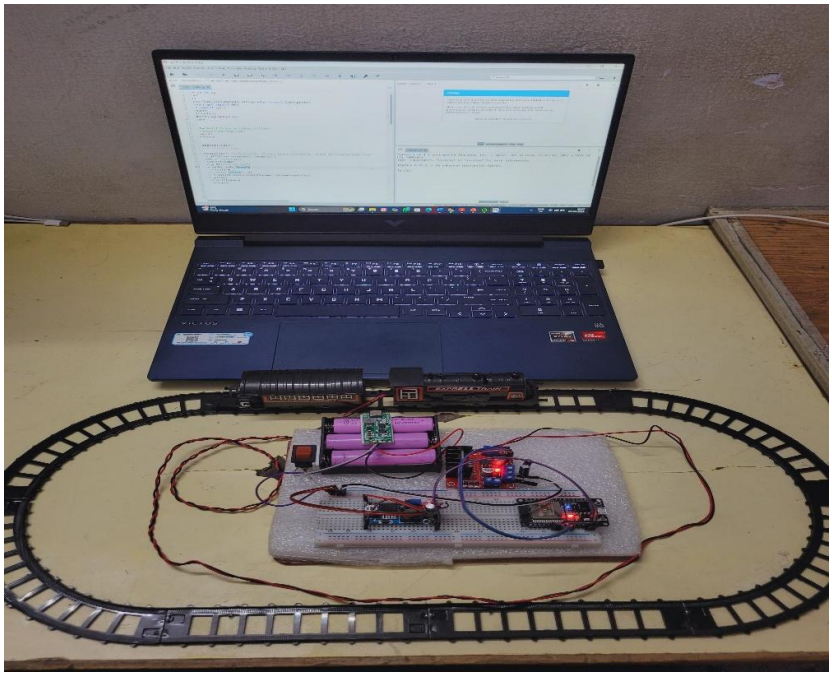
Prototype Model



V. RESULTS

ID	TEST CASE	INPUT	PASS CRITERIA
D_CAP	Dataset capturing	Images	All the animal images are being captured and stored in a folder successfully
D-LAB	Dataset labelling	Image	All the animal images are labeled and stored successfully
U_CONN	User Connecting the L298n motor with ESP 32 microcontroller	L298n motor and ESP 32	All the hardware connections are made successfully
U_UPLOAD	Userupload the code into ESP 32 module	Microcontroller code	Source code to control the servo motor rotation has beensuccessfully uploaded to the Arduino uno module
U_ACTIVATE	Activate wild animal protection from train accident engine	Activation of Code	User successfully activates the wild animal protection Engine from train to detect the animal intrusion and alert to the specified driver to slow down the Train speed.

Table : Test Cases

VI. CONCLUSION AND FUTURE SCOPE

This project uses the deep learning model Faster RCNN to prevent train accidents in dense jungles from killing or seriously injuring wild animals. To deploy this designed model successfully, we initially collect the wild animal dataset synthetically in different angles and ranges. We label the obtained dataset to extract the animal coordinates from each

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frame in XML files. We use all the original dataset images and the labeled XML files in the Google Colab environment to train the Faster R-CNN model for the desired iterations. After training the dataset with Faster RCNN, we integrate the trained data with live streaming frames from the train's camera. In this process, we test each frame for the presence of wild animals on the train track. If an animal is found on the train track, then instantly the loco pilot is alerted for the same, and then by using the IOT model, the train's speed will be decreased in a simulated environment.

FUTURE WORK

As the future scope of this research, this can be enhanced to work in real time CCTV live streaming from the train engine and slow down the train and it can be applicable to all other vehicles too.

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