

RIPRESO : Elephant protection system against collision with trains

Minnu Jayan C¹, Aaromal U D², Amal A S³, Leya Joy⁴, Mohammed Nihaan M⁵

¹Electronics and Communication Engineering, Assistant Professor, Marian Engineering College.

²Electronics and Communication Engineering, U G Student, Marian Engineering College.

³Electronics and Communication Engineering, U G Student, Marian Engineering College.

⁴Electronics and Communication Engineering, U G Student, Marian Engineering College.

⁵Electronics and Communication Engineering, U G Student, Marian Engineering College.

Abstract- According to a survey conducted by the government, a total of 35,732 animals which include 65 elephants have been killed from January 2016 to June 2019. After every collision, the engine, tracks, and insulations are checked before leaving the spot. This causes a delay of around 30 minutes. According to an information received through RTI, if a passenger train running on diesel stops for a minute, then it results into a loss of Rs 20,401. On the other hand, it is Rs 20,459 in case of an electric train. Similarly, for a diesel-run goods train's one minute stoppage, railways incur a loss of Rs 13,334 and it is Rs 13,392 for an electric goods train.

So, to avoid death of animals due to collision and to maintain steady functioning of railway, we introduce Ripreso. This device is used to keep animals such as elephants, wild boars etc. away from the estimated area without causing any harm to them.

It can also be used to scare away animals from buildings located near forest areas. Area to be protected is divided into three different zones. When the animal enters the area, Ripreso produces different frequency sounds at different zones and at the same time alert messages are send to concerned authorities. When the animal leaves the zone, Ripreso turns off automatically.

1. Introduction

As the technology is growing immensely in recent years, improvisation needs to be made not only for human but also for animals. Our project aims to achieve protection for elephants.

According to a survey conducted by the government, a total of 186 elephants were killed in the last 10 years due to train collision. After every collision, the engine, tracks, and insulations are checked before leaving the spot. This causes a delay of around 30 minutes. According to an information received through RTI, if a passenger train running on diesel stops for a minute, then it results into a loss of Rs 20,401. On the other hand, it is Rs 20,459 in case of an electric train. Similarly, for a diesel-run goods train's one minute stoppage, railways incur a loss of Rs 13,334 and it is Rs 13,392 for an electric goods train. So, to avoid death of animals due to collision and to maintain steady functioning of railway, we introduce RIPRESO. This device is used to keep elephants away from the estimated area without causing any harm to them, also reduce the loss of railway and maintain the habitat of elephants.

2.Literature Survey

2.1 Plan Bee

The plan installs unique devices along the railway tracks. These devices create the buzzing sounds of swarming bees. Elephants get irritated to the buzzing sounds of bees. And try to stay away from the sound. Thus, by creating the buzzing sound, the device keeps the elephants away from the track. The sound produced by the device is audible from a distance of 400 metres.

The device was first installed near Kamakhya station in Assam. And today the devices are installed in more than 56 locations. These places are under the jurisdiction of the North Frontier Railways. So far, Plan Bee has saved 950 elephants.

According to Ministry of Environment, Forest and Climate Change, between 2009 and 2021, more than 186 elephants were killed in train accidents. Of these, Assam accounted for the largest number of elephant deaths due to train accidents. It was followed by West Bengal and Odisha.

2.2 IIT-Delhi built sensor on railway tracks

When fitted to railway tracks, the sensors would track visuals, movement, sound, lights and other parameters before corroborating the inputs and feeding them into an automated algorithm. The algorithm would then decide if an elephant or a herd was near the tracks. A message would be sent to the nearest station master and the driver of trains about to pass through the area.

If the train is 3 km away from the site of elephant trespassing, the brakes would automatically get activated and the train would stop.

2.3 Eco bridge Solution

The eco bridges are natural corridors. They are links in habitat that connect two larger wildlife zones. They are usually constructed in elephant corridors. Sometimes, the road and railway construction through the elephant corridor obstructs the movement of elephants from one habitat to the other. In such cases, a natural link over or under the road and railway track will help them cross the corridor.

2.4 Acoustic sensors

Acoustic sensors are used to capture the elephant trampling sound. Elephants communicate with each other elephant by low-occurrence sounds which commute distances of all kilometres. The approximately common elephant invite is the roar, which extends directed toward the infrasound band. The roar is a harmonic sound mutually an integral occurrence in the range of 15-35Hz and a term between 0.5 and 5s. A typical roar by the whole of a valuable Signal-to-Noise Ratio (SNR). The sensual detection of elephants by their calls is currently the approximately promising clear towards an early warning position that is efficient to recognize the reality of elephants during large distances.

So appropriately research on acoustic examination of elephant calls has addressed fully selective tasks, a well-known as the concern of elephants by their calls and the experiment of particular call types, e.g. roar types. Acoustic

detection system for free-ranging elephants which helps to detect the elephant sound that is robust to the different noise resources in the field. A data set of recorded sound under normal field situation. The result shows a detection rate of rumble 85.7% and a false-positive rate of rumble 14.2% on a database and the method helps to achieve the robustness of the detector.

2.5 Experimental crosswalk solutions

Standard exclusion fences lead animals towards an opening about 50 m wide where movement detectors, thermal cameras, and video cameras monitor the presence and behaviour of animals and trigger the warning system when trains approach. Crushed stone or cattle guards will discourage ungulates from entering the fenced area.

These experimental crosswalks serve as test locations where the effect of various stimuli can be studied. The crosswalks will be placed at feasible locations where animals are known to cross the railway (detected by snow tracking) and are dispersed approximately 2 km apart.

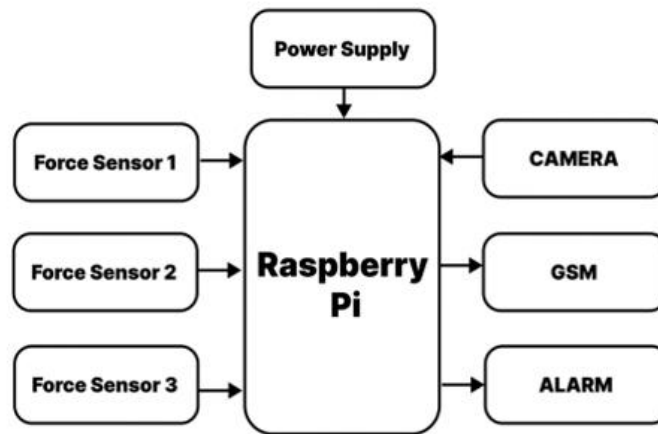
The crosswalks will be constructed so that terrain conditions, vegetation and ground substrate naturally and effectively lead animals toward the fence gap and over the railway. Cattle guards or large crushed stones alongside the crossings will discourage animals from entering the fenced railroad track. Escape ramps or one-way gates will be installed to allow animals to exit if they get trapped inside the fence nevertheless.

2.6 Train-triggered wildlife warning system

An electronic system for reducing wildlife–train collisions that combines the precise signaling of active warning systems (e.g., road–railway crossing signals) with the flexibility of installation and affordability of passive warning systems (e.g., headlight reflectors). One is based on paired but spatially separated devices in which the first device detects a passing train and relays that information to a distant warning device positioned within the strike zone (hereafter, the passing relay). The other is based on a single device positioned within the strike zone that predicts train arrival time from a distance and activates integrated warning stimuli at the desired time (hereafter, the approach detector). Both methods can be implemented with low-cost, off-the-shelf components, assembled with basic electronics tools, and installed without affecting railway infrastructure or operations.

3. Proposed method

3.1 Block diagram



Raspberry pi

All the components are interfaced to the raspberry pi. It controls the various components according to the entered program.

IR positioning camera

This infrared camera tracks the movement of elephant and transmit the data back to raspberry pi.

Adafruit Ultimate GPS

When both the conditions of force sensor and camera get activated GPS will send information to the nearest railway.

Speaker

When both the conditions of force sensor and camera get activated, the speaker play the sound of bees to scare the elephant away.

Force sensor

Force sensor act as a transducer that converts the mechanical load of train into an electrical output signal.

3.2 Materials Required

1.Raspberry pi

Raspberry Pi is the name of a series of single-board computers made by the Raspberry Pi Foundation. All the components are interfaced to the raspberry pi. It controls the various components according to the entered program.

2.IR positioning camera

This infrared positioning camera is equipped with an I2C interface, allowing for easy control with raspberry pi. This infrared camera tracks the movement of elephant and transmit the data back to raspberry pi.

3.Force sensor

Force sensor act as a transducer that converts the mechanical load of elephant into an electrical output signal.

4. Adafruit Ultimate GPS

When both the conditions of force sensor and camera get activated GPS will send information to the nearest railway.

5. Speaker

When both the conditions of force sensor and camera get activated the speaker play the sound of bees to scare the elephant away.

3.3 Program logic

Open CV

OpenCV is a Python library that allows you to perform image processing and computer vision tasks.

`cv2.imread()`: method loads an image from the specified file.

`cv2.imshow()`: method is used to display an image in a window. The window automatically fits the image size.

`waitKey` function is used to wait for a keystroke event when displaying images or playing videos.

`Haar_cascade` : is an algorithm that can detect objects in images, irrespective of their scale in image and location.

`face_cascade` : is a pretrained classifier for face.

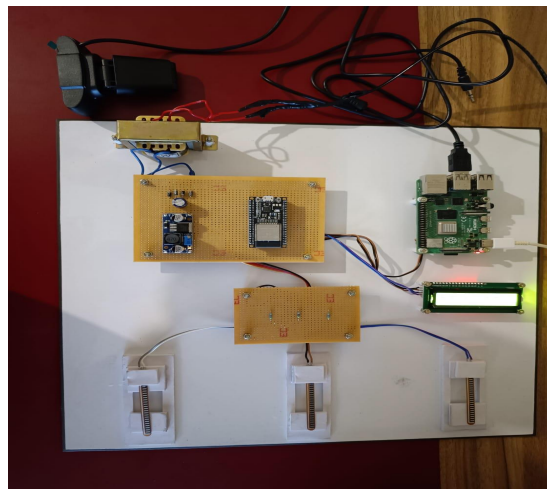
`eye_cascade` : is a pretrained classifier for eye.

Tensorflow

TensorFlow is an end-to-end open source platform for machine learning. TensorFlow is a rich system for managing all aspects of a machine learning system

Three stages in Tensorflow - preprocess , predict , post process.

4. Results



The experimental set up of RIPRESO. The force sensors, LCD and other componets are connected to Raspberry pi. The camera detects the elephant and when the pressure is applied in the expected range the LCD displays message.

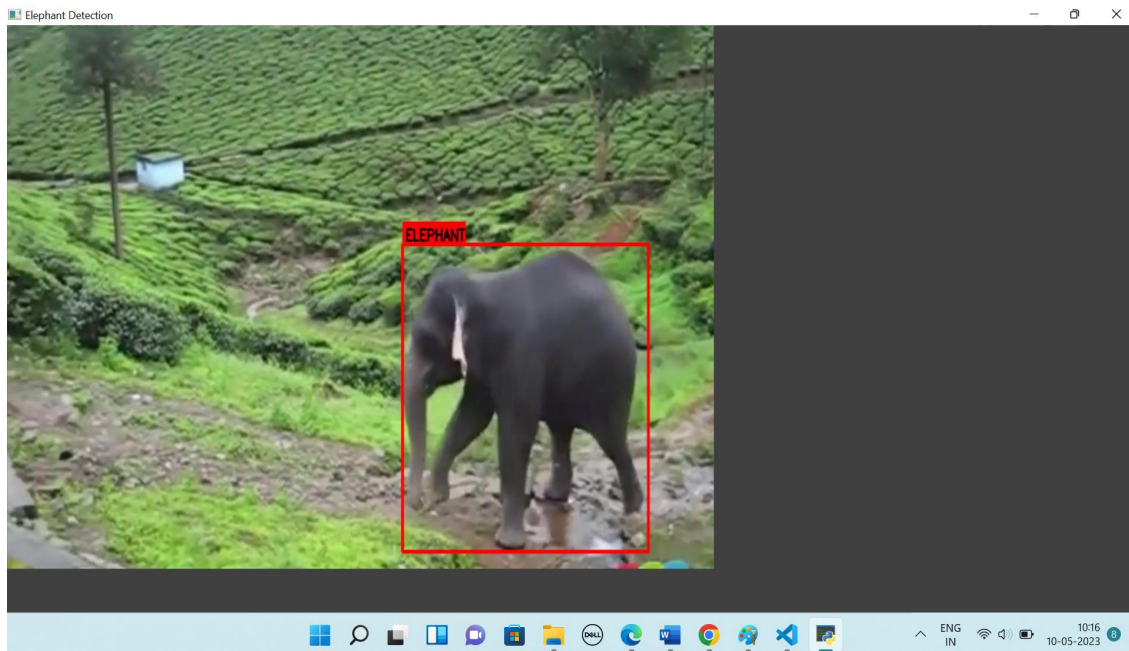
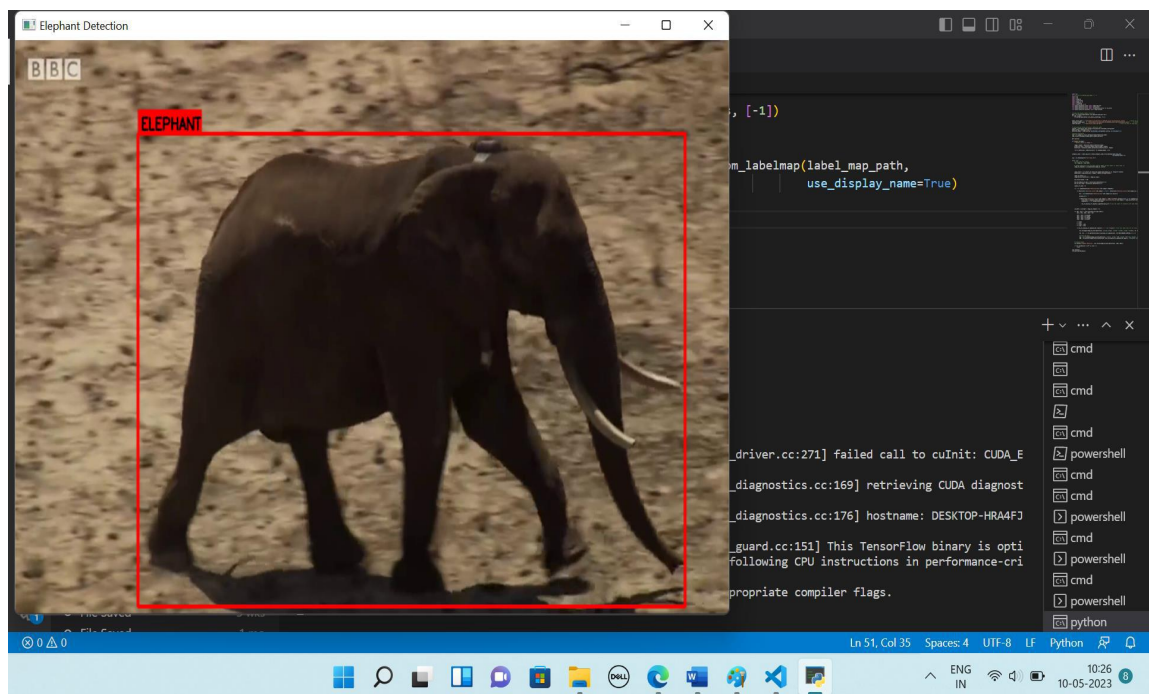


Figure shows the detection of elephant using the algorithm.



Detection of elephant is done and verified.

5. Future works

It can be used near railway track to protect elephants from train accidents. By installing RIPRESO near railway tracks not only elephants but also other animals and human beings can be saved. The another benefit of using RIPRESO is saving money and time of Indian railway.

It can be used in places where wild boar attack happens regularly.

6. References

- [1] AllenWR, *Ovulation pregnancy, placentation and husbandry in the African elephant (Loxodonta Africana)*, Philosophical Transactions of the Royal Society of London, SeriesB Biological Sciences(2006).
- [2] Deepak Punetha, Deepak Kumar and Vartika Mehta Design *and Realization of the Accelerometer based Transportation System(ATS)*, in International Journal of Computer Application(2012).
- [3] Robin Des Bois, *Information and analysis bulletin on animal poaching and smuggling with the encouragement and financial support of the Foundation Brigitte Bardot*, the Ligue pour la Protection des Oiseaux and the Foundation Franz Weber(2015). [4] Sha Tao,VasileiosManolopoulos, Saul Rodriguez, Ana Rusu, Real-time Urban Traffic State Estimation with AGPS Mobile Phones as Probes Journal of transportation technologies(2012).
- [5] Stevenson MF, Walter O, *Management guidelines for the welfare of zoo animals:elephants, Loxodonta African and Elephas maximus*.2nd ed. London: British & Irish Association of Zoos & Aquariums(2006).
- [6] Sukumar.R., *The Asian Elephant; Ecology and Management*, Cambridge: Cambridge University Press(1989).
- [7] *UDOT Wildlife and Domestic Animal Accident Toolkit* by Utah Department of transportation Environmental Services & Wildlife & Domestic Animal Accident Quality Improvement Team. Report No. UT 08.07,4501 So 2700 West Salt Lake City, Utah 84114 (2008)