EasyChair Preprint

№ 6666

Animal Detection for Road Safety Using Deep Learning

S Sanjay, Sudhir Sidhaarthan Balamurugan and
Sai Sudha Panigrahi

September 23, 2021

Animal Detection for Road safety using Deep Learning

Sanjay S[1][0000-0001-6339-9651], Sudhir Sidhaarthan B[2][0000-0001-9042-6424], Sai Sudha Panigrahi[3][0000-0003-2857-5853]

[1] Department of Computer Science, RMK Engineering College, Chennai, India
[2] Department of Computer Science, Lovely Professional University, Punjab, India
[3] Department of Computer Science, Amrita School of Engineering, Coimbatore, India
sanjays2402@gmail.com

Abstract: Over the years, Accidents due to animals crossing the road at unexpected moments is still been a great cause of road death. Roads near the forest are dark and dense hence drivers are not able to spot the animals clear. Truck drivers face issues due to blindspot regions. In this paper, we are proposing a model that can efficiently detect the animals and alarm the driver. Using Machine learning - Deep learning algorithm we are segregating the animals with the help of a huge open-source dataset. Using convolution neural networks the model will learn by itself to predict the object for every frame of the image received from the live camera. If the machine marks object as an animal the system gives an alert of 3 seconds to make the driver conscious about the approaching animal. This model doesn't stop with few animals as the dataset is open-sourced the variety of animals detection keep increasing. The model gives 91% accuracy.

Keywords: Machine Learning (ML), Deep Learning (DL), Road safety, Convolution Neural Networks (CNN), Image Recognition

1 Introduction

In the rapid increase in construction of the road in between forest and wild animal dense areas, it became very difficult for the driver to ride. Various animals cross the road. Sometimes the driver may not be able to spot the animal, which sometimes leads to a fatal accident.

With the help of machine learning and a deep learning algorithm, we can add a large set of animal images [13] and let the machine predict if there is any obstacle in between also even if there is an animal in the sight of the vehicle. The main aim of this model is to ease the difficulty of humans constantly checking the road and let the computer train themselves to detect the upcoming difficulties.

Deep learning neural networks are the collection of a large set of convoluted neural networks, each neural network helps in the process of predicting the expected result.

The application of this model can be extended very far. There is no limit to explore this model.

2 Literature Survey

This model helps the driver to avoid impacting animals on the road. We've taken references from many previous research papers related to this model. We found some models were lacking in configuration, speed, and cost. Hence, we're proposing a model that beats the other model.

[1], [4] Detection of Big Animals on Images with Road Scenes using Deep Learning, used various high-level deep learning algorithms to detect the object. [1] used data set based on Google Open Images and COCO datasets which contain around 20,000 random images. [1] used network architectures such as VOLOv3, Fast R-CNN. The drawback of this model is high component power. They need high computational energy and speed for quick and efficient results.

[2] Large animal detection and continuous traffic monitoring on highways used radar processing technology to send out an infrared beam from the tower or vehicle. When the beam gets interrupted and disturbed the system warned the driver and nearby my vehicle too. This model gives out lots of false alarms.

[3], [5] created a support vector model to detect and classify the animals using IR and camera which is then connected to the main MUC where the vector machine finds the key points of animals. The efficiency of this model is higher than [1], [2].

[6], [1], [4] gets the real-time feed and converts into the greyscale image or easier detection of key points. [6] passes the greyscale to the convoluted neural network and it passes through another layer where the images are patched around its candidates and uses the training dataset to label the animals. We can start sending alerts instead of identifying the animal. Because of the use of the transfer sampling technique, which is explained in [6], this model yields high accuracy.

As discussed in [2], using radar processing technology to send out a UV beam from the tower or vehicle is outmoded and result in false-positive conditions [5].

3 Survey Report

A) Major cause of road accident:

Last year in India, about 260,000 crashes occurred on road due to animals wandering around the road. In which about 12,000 humans were injured and 150 people died due to impact.

B) Blindspot region issue:

Most trucks are higher from the ground level. They won't be able to notice the animals that go under the vehicle.

4 Precaution

Before one starts the journey, one must ensure to get a good amount of rest and have enough sleep to continue the journey. Suppose he/she is falling asleep they could transfer the driving to a co-passenger or park the vehicle at the roadside to get some sleep.

5 Working

5.1 Convolutional neural network

Machine learning algorithms have many subsets under them, Convolution neural network is one among them. It consists of many hidden layers. The number of layers depends upon the user and the [6], [9] complexity of the task. It has 2 main layers, the input layer, and the output layer. A CNN is mostly used for data interpretation, Natural language processing, and Image processing.

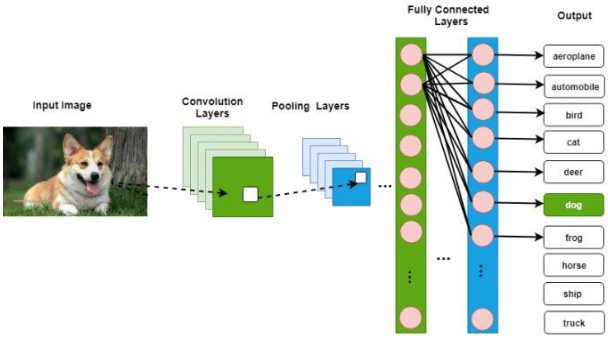

Fig. 1: Neural Network

We take the video from the live camera, and it is looped for every frame, each input image contains 3 colors Red, Green, and Blue. [7], [9] They are denoted by their pixel value. The work of the first layer is to get the image and mark the pixel color

value. Then the image moves to the next CNN layer, the CONV layer. It helps calculate the output neurons that are connected to the input. Each neuron helps to calculate the product between their weights and the area connecting the input layer.

The third layer helps to apply unit wise activation function for each node. And moves to the next node, POOL Layer where sampling operation along with the spatial dimensions is performed which results in the required size.

Then the neurons are moved to the last layer, Fully connected, this helps to [5] calculate the class scores. In this last year, the weight of the preceding set relates to each neuron.

5.2 Convolution Layer

In this layer, the features are taken out from the live feed image. Each image is produced with the help of a binary pixel which is either 1 or 0. This layer helps to draw out that from the image. We use a suitable filter to draw out the pixel value. This helps to do various tasks on a given image, such as blurring the unwanted region, sharpening the image for better clarity.

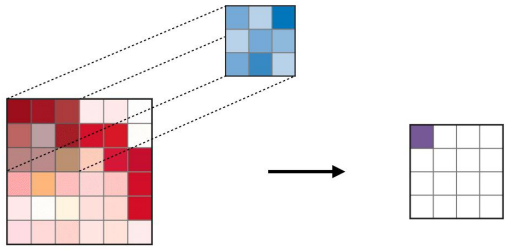

Fig. 2: Convolution Layer

5.3 Pooling

Usually, the image would contain lots of unwanted parts and parameters when the image size is larger. Pooling helps to reduce the pixel count by using the user requirement or instruction.

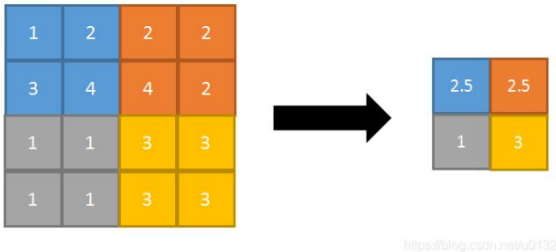

Fig. 3: Pooling

Sometimes their count is more than 1024 pixels in an image, which makes the computation longer. This is not efficient. So, the user uses pooling to merge the nearby pixel to a single pixel. This helps to reduce the size by n times. Therefore, the computation time is reduced.

5.4 Flattening

The result from Pooling will be in the form of a 2D array. But the machine can't work with the 2D array easily. So, to ease the process[11] we convert the 2D array into a 1D array. Thus, the result produced here will be in the form of a long linear vector. And this is passed to the final classification layer

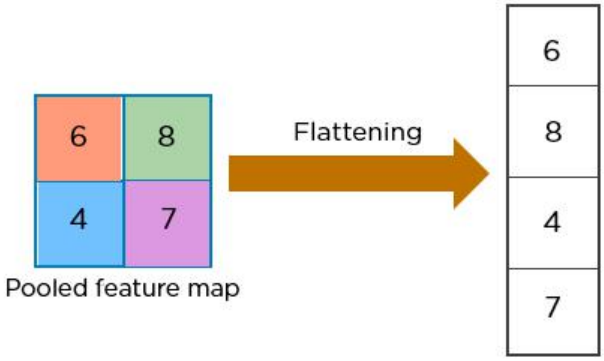

Fig. 4: Flattening

5.5 Fully Connected

This layer is used to combine all the features to accurately predict the required output.

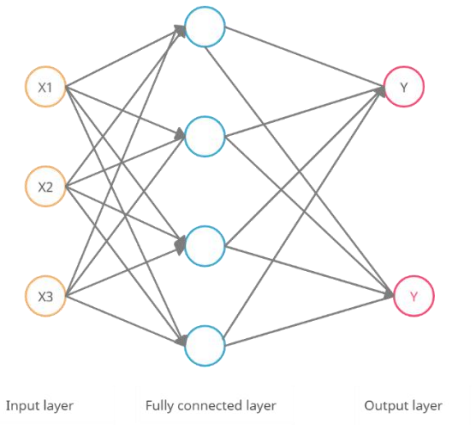

Fig. 5: Fully Connected Network

The neural network is tightly connected to each node, This helps to increase the efficiency of the model. Also, the process is slight into multiple parts so the load on a single processor thread is divided.

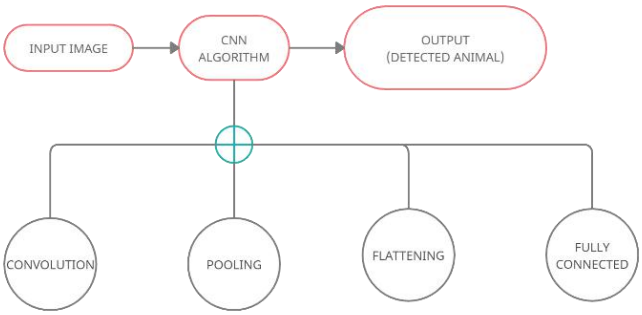

Fig. 6: Block Diagram

6 Flowchart

The flow chart below explains the complete model. The is trained with the help of [V] and the model is trained with the help of 20,000 openly available datasets.

When the driver is driving, the video is split into a fraction of images. These images are set into CNN models for every frame. If the CNN [12] marks the animal, then the system starts an alarm and warns the driver to pay attention to the animal which is approaching the vehicle. After 3 seconds of warning, the alert disappears and the driver can drive as usual.

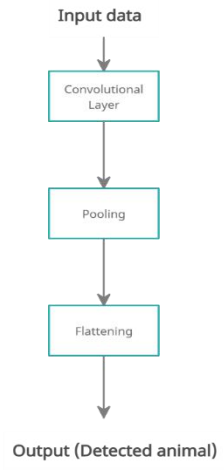

Fig. 7: Flowchart

7 Results-Screenshots

After training the model, we tested with a random image from the internet. The result is as follows Fig. 8

Fig. 8: Dog's Result

The model marked the position of the animal and raised an alarm.

We tested the model with another image of a cow from the internet, The result is shown in Fig. 9

Fig. 9: Cow's Result

8 Conclusion

Overall the model gives 91% of accuracy under various lighting and position. Which proves this system to be a dealbreaker. The other algorithms and models are

highly complex and require high components. There are not many demerits in this model. All it needs is a good quality video frame and Camera. Also, the quickness of the model depends on the GPU used as we have to process each image frame faster.

This model is tested with 200 random images from the internet. In which around 180 predictions were perfectly correct. The efficiency of this model can be improved if the GPU power is upgraded and camera quality is improved.

This model is an example of a low-cost efficient system that can save thousands of lives every day around the globe.

9 Future Scope

Further, the model can be improved with the help of an IR device which can improve the vision at night time.

Distance measurement can be added to reduce alertness. So, that the system won't alert if the animal is far from the vehicle.

Mechanically linking the sensor with Brakes and steering to slowly park the vehicle on the side of the road. Creating a sort of high-frequency Sound/Vibration to the seat to make the driver alert.

10 References

[1] Dmitry Yudin; Anton Sotnikov; Andrey Krishtopik, Detection of Big Animals on Images with Road Scenes using Deep Learning, 2020

[2] A. Mukherjee; S. Stolpner; X. Liu; U. Vrenozaj; C. Fei; A. Sinha, Large Animal Detection and Continuous Traffic Monitoring on Highways, 2013

[3] Slavomir Matuska; Robert Hudec; Miroslav Benco; Patrik Kamencay; Martina Zachariasova, A novel system for automatic detection and classification of animal, 2014

[4] Nidhal K. El Abbadi; Elham Mohammed Thabit A. Alsaadi, An Automated Vertebrate Animals Classification Using Deep Convolution Neural Networks, 2020

[5] Emrah Şimşek; Bariş Özyer; Levent Bayındır; Gülşah Tümüklü Özyer, Human-animal recognition in camera trap images, 2018

[6] Benjamin Kellenberger; Diego Marcos; Sylvain Lobry; Devis Tuia, Half a Percent of Labels is Enough: Efficient Animal Detection in UAV Imagery Using Deep CNNs and Active Learning, 2019

[7] He, K., Zhang, X., Ren, S., Sun, J.: Deep residual learning for image recognition. In: CVPR. pp. 770-778 (2016).

[8] Kamencay, P., T. Trnovszky, M. Benco, R. Hudec, P. Sykora and A. Satnik. Accurate wild animal recognition using PCA, LDA and LBPH, In: 2016 ELEKTRO. Strbske Pleso: IEEE, 2016, pp. 62–67.
[9] WU, J. L. and W. Y. MA. A Deep Learning Framework for Coreference Resolution Based on Convolutional Neural Network. In: 2017 IEEE 11th International Conference on Semantic Computing (ICSC). San Diego: IEEE, 2017, pp. 61–64.
[10] P.M. Vitousek, H.A. Mooney, J.Lubchenco, J. Melillo, "Human domination of Earth's ecosystems", Science, vol. 277, no. 5325, pp. 494-499, 1997. (ICSC). San Diego: IEEE, 2017, pp. 61–64.
[11] A. Gomez., A. Salazar, F. Vargas, towards automatic wild animal monitoring: Identification of animal species in camera-trap images using very deep convolutional neural networks, 2016.
[12] Tiber Trnovszky, Patrik Kamencay, Richard Orjesek, Miroslav Benco, Peter Sykora. Animal recognition system based on convolutional neural network.
[13] S Kanimozhi;G Gayathri;T Mala, Multiple Real-time object identification using Single shot Multi-Box detection, 2019
[14] Shraddha Mane;Supriya Mangale, Moving Object Detection and Tracking Using Convolutional Neural Networks, 2018
[15] Muhammet Özbay;Mehmet Cihan Şahingil, A fast and robust automatic object detection algorithm to detect small objects in infrared images, 2017