OBJECT DETECTION USING DEEPLEARNING

Chaya.R
School of ECE, REVA University,
Bengaluru, India
chaya.ravindra@gmail.com

B.Neeraj Kumar Reddy
School of ECE, REVA University,
Bengaluru, India
bneerajkumarreddy@gmail.com

Bokka Shekar Reddy
School of ECE, REVA University,
Bengaluru, India
shekarreddy1374@gmail.com

B.Hemanth Kumar
School of ECE, REVA University,
Bengaluru, India
bhemanthk29@gmail.com

Danish Khan
School of ECE, REVA University,
Bengaluru, India
dxnishkhxn03@gmail.com

***Abstract*—This abstract presents a deep learning-based approach for car detection in traffic surveillance systems. Leveraging convolutional neural networks (CNNs) and state-of-the-art object detection frameworks like You Only Look Once (YOLO) or Single Shot MultiBox Detector (SSD), our system achieves real-time processing and high detection accuracy even in challenging environments. We employ transfer learning and data augmentation techniques to fine-tune pre-trained models on annotated traffic scene datasets, enabling effective adaptation to diverse scenarios. Experimental results demonstrate superior performance in accurately localizing and classifying cars, outperforming existing methods. Our proposed system promises significant contributions to traffic safety, management, and urban planning efforts through enhanced surveillance capabilities.**

I. Introduction

The integration of deep learning into car detection systems has ushered in a new era of innovation within the automotive industry. Deep learning, a subset of artificial intelligence inspired by the human brain's neural networks, has demonstrated remarkable capabilities in recognizing and understanding complex patterns in data. In the context of car detection, deep learning algorithms have proven to be particularly effective, enabling vehicles to perceive their surroundings with unprecedented accuracy and efficiency.

Car detection holds critical importance in various domains, from enhancing road safety to enabling autonomous driving capabilities. Traditional computer vision techniques often struggled to cope with the challenges posed by real-world scenarios such as varying lighting conditions, occlusions, and diverse vehicle shapes. However, deep learning models, especially convolutional neural networks (CNNs), have shown remarkable resilience in handling these challenges by autonomously learning discriminative features directly from raw image data.

One of the key advantages of deep learning-based car detection systems is their ability to adapt and generalize across different environments and scenarios. By leveraging large datasets annotated with vehicle instances, deep learning models can learn robust representations of cars, enabling them to accurately detect vehicles in real-time. Moreover, the continuous evolution of deep learning architectures and algorithms has led to significant improvements in detection accuracy and speed, making them increasingly suitable for deployment in resource-constrained automotive platforms.

Looking ahead, the future of deep learning in car detection holds immense promise. As research and development efforts continue to push the boundaries of AI technology, we can expect further advancements in perception, prediction, and decision-making capabilities of autonomous vehicles. Additionally, the integration of deep learning with complementary sensor modalities such as LiDAR and radar is poised to enhance the overall robustness and reliability of car detection systems, paving the way for safer and more efficient transportation systems of the future.

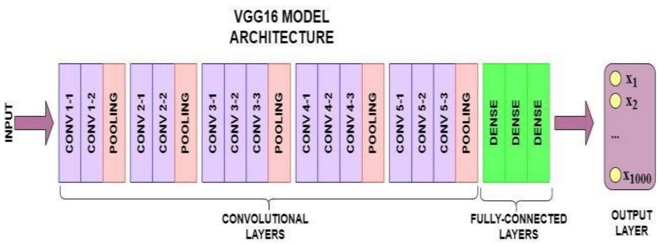

Fig 1. VGG Model Architecture

II. LITERATURE SURVEY

The literature surrounding deep learning-based car detection encapsulates a dynamic field marked by continuous innovation and refinement. Researchers have delved into a plethora of methodologies aimed at improving the accuracy, efficiency, and robustness of car detection systems. Central to this pursuit are advancements in deep learning architectures, with models like Faster R-CNN, YOLO, and SSD representing prominent milestones. These architectures leverage sophisticated features such as region proposal networks and feature pyramid networks to enable precise and swift identification of vehicles within complex scenes.

Augmentation techniques and preprocessing steps have emerged as indispensable tools in the training pipeline of deep learning-based car detection models. By enriching training datasets through strategies like random cropping, rotation, and color manipulation, researchers enhance model robustness and adaptability to diverse environmental conditions. Additionally, preprocessing steps such as image normalization aid in standardizing input data, facilitating more effective model training and inference across different contexts.

Transfer learning stands out as a key strategy for leveraging pre-existing knowledge and accelerating model development in car detection. By leveraging CNNs pretrained on large-scale image datasets like ImageNet, researchers bootstrap the learning process, enabling models to effectively extract features relevant to car detection tasks. Fine-tuning techniques further refine these learned features, tailoring them to the specifics of the target domain and enhancing detection performance in real-world scenarios.

The integration of multiple sensor modalities, including cameras, LiDAR, and radar, represents a frontier in deep learning-based car detection research. Fusion techniques that combine information from these disparate sensors hold the promise of improving detection accuracy and reliability, particularly in challenging conditions such as low light or inclement weather. By harnessing complementary data streams, researchers aim to create more robust and comprehensive car detection systems capable of operating effectively in diverse environments.

Looking ahead, the literature highlights several avenues for future exploration and refinement in deep learning-based car detection. These include the development of lightweight architectures optimized for deployment on resource-constrained platforms, as well as the exploration of novel techniques for handling complex scenarios such as occlusions, crowded scenes, and non-standard vehicle shapes. Moreover, continued collaboration between academia, industry, and policymakers will be essential in addressing ethical, safety, and regulatory considerations to ensure the responsible deployment of deep learning technologies in automotive applications.

III. DESIGN AND IMPLEMENTATION

In this section we outline the basic design of our model and describe the implementation of the same

Step-1:Our DEEP LEARNING BASED ON CAR DETECTION SYSTEM is implemented by Jetson Nano in hardware implementation.

Step-2:As in software it is implemented in Google colab notebook using TPU as it is free of cost.

Step-3:The dataset should be downloaded like images,videos e.t.c to implement this project as per the code that we give the path must be given.

Step-4:Upload some sample images and videos notedown the accuracy and validation loss and training loss by changing the epocs.

Step-5:In this last step we can see the cars are detected.

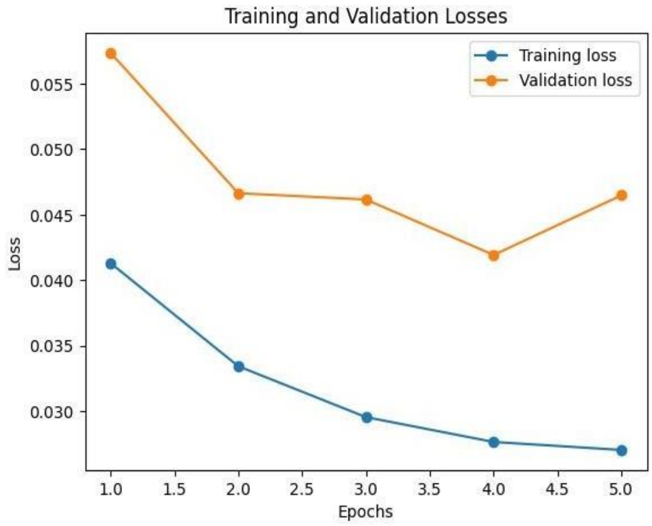

Fig 2.Losses

IV. ALGORITHMS AND MATH

Here we are going to use VGG16 for Car Detection System i.e bounding default boxes used for Car Detection which allows the algorithm to match the Faster R-CNN accuracy using Lower Resolution Images which results in higher speed.

A. VGG16 Algorithm

- The VGG16 calculation is a convolutional brain organization (CNN) design that acquired noticeable quality for its viability in picture order undertakings. Created by the Visual Calculation Gathering (VGG) at the College of Oxford, VGG16 is described by its profound design, comprising of 16 layers, subsequently the name. The organization is made out of a progression of convolutional layers, trailed by max-pooling layers, and finished off with completely associated layers.
- One of the vital elements of VGG16 is its uniform design, where convolutional layers are stacked consistently, with little 3x3 channels and a step of 1, keeping up with spatial goal all through the organization. This consistency improves on the plan and works with more profound organizations without the requirement for bigger open fields. Notwithstanding, it additionally makes VGG16 computationally costly contrasted with additional cutting edge structures because of its enormous number of boundaries.
- In spite of its computational expense, VGG16 has shown uncommon execution on different benchmark datasets, for example, ImageNet, accomplishing cutting edge brings about picture grouping errands. Its prosperity lies in its capacity to catch mind boggling highlights at various spatial scales through the progressive course of action of convolutional layers, empowering it to learn rich portrayals of visual information.

V. RESULTS

Overall, results in deep learning-based car detection showcase the progress made in developing robust, efficient, and reliable detection systems capable of operating in diverse real-world scenarios. Continued research and development efforts aim to further improve detection accuracy, speed, and adaptability, ultimately advancing the deployment of autonomous driving technologies and enhancing road safety

Shows the values of those different metrics in car detection.Here the car is passing so it detects that is a car and mentioned.

This results in accuracy,speed,robustness,transfer learning,instance segmentation,efficiency Overall, deep learning-based car detection systems have made significant strides in terms of accuracy, speed, robustness, and efficiency, enabling a wide range of applications across industries.

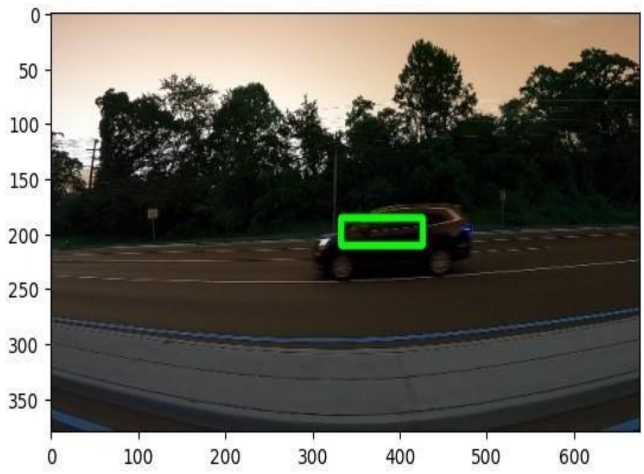

Fig 3.Car detected

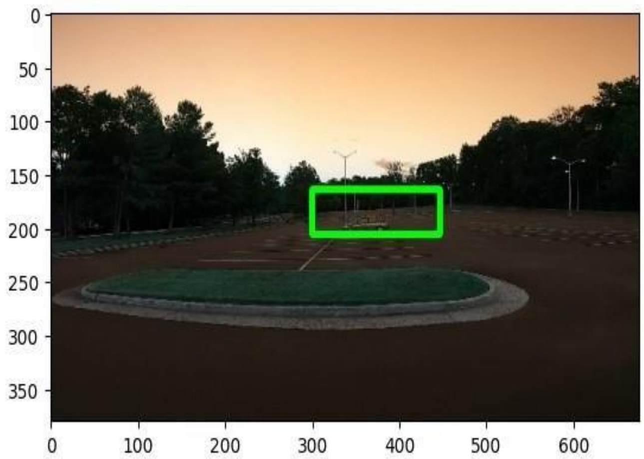

Fig 4.Car detected

Fig 5.Car detected

VI. CONCLUSION

The evolution of deep learning-based Car detection marks a significant leap forward in computer vision technologies. The maturation of models has led to impressive gains in accuracy and efficiency, enabling applications in diverse industries. Real-time inference capabilities and the impact of transfer learning have expanded the reach of car detection to critical domains such as autonomous vehicles and surveillance. As innovation continues, deep learning-based car detection is poised to play an increasingly vital role in shaping technological landscapes. The field's continuous evolution promises solutions that are not only accurate and efficient but also transparent and customizable, paving the way for broader adoption and impact across industries.

ACKNOWLEDGMENT

The authors would like to thank REVA University for the continuous support, infrastructure and encouragement to carry out the research.

REFERENCES

[1] Hsieh, Cheng-Hsiung, et al. "Real-time car detection and driving safety alarm system with Google tensorflow object detection API." *2019 International Conference on Machine Learning and Cybernetics (ICMLC)*. IEEE, 2019.

[2] M. A. Hossain, M. A. Rahman, R. Khanom, S. Sultana and A. Hossain, "Real-time Vehicle Detection and Classification on the Padma Multipurpose Bridge in Bangladesh Using a Deep Learning Model," *2023 International Conference on Next-Generation Computing, IoT and Machine Learning (NCIM)*, Gazipur, Bangladesh, 2023, pp. 1-6, doi: 10.1109/NCIM59001.2023.10212549.

[3] Irawanto, A. Sunyoto and B. Setiaji, "Deep Learning Based Car Detection System Using Convolutional Neural Network and Haar Cascade Classifier," *2023 6th International Conference on Information and*

Communications Technology (ICOIACT), Yogyakarta, Indonesia, 2023, pp. 389-394, doi: 10.1109/ICOIACT59844.2023.10455934.

[4] Z. -H. Huang, C. -M. Wang, W. -C. Wu and W. -S. Jhang, "Application of Vehicle Detection Based On Deep Learning in Headlight Control," *2020 International Symposium on Computer, Consumer and Control (IS3C)*, Taichung City, Taiwan, 2020, pp. 178-180, doi: 10.1109/IS3C50286.2020.00053.

[5] M. Nguyen and T. K. Mohd, "Reinforcement Learning for a Raspberry Pi Smart Car for Lane Detection Using OpenCV," *2023 IEEE 13th Annual Computing and Communication Workshop and Conference (CCWC)*, Las Vegas, NV, USA, 2023, pp. 102-107, doi: 10.1109/CCWC57344.2023.10099118.

[6] A. Kumari, H. R. Daksh, A. Utsav and A. Abhishek, "Self-Automated Car with Obstacles Detection," *2022 13th International Conference on Computing Communication and Networking Technologies (ICCCNT)*, Kharagpur, India, 2022, pp. 1-6, doi: 10.1109/ICCCNT54827.2022.9984336.

[7] S. M. S, S. P. Shankar, H. J. B. J, L. L. Narayana and N. Gumalla, "Car Crash Detection System using Machine Learning and Deep Learning Algorithm," *2022 IEEE International Conference on Data Science and Information System (ICDSIS)*, Hassan, India, 2022, pp. 1-6, doi: 10.1109/ICDSIS55133.2022.9915889.

[8] M. Mostafa and M. Ghantous, "A YOLO Based Approach for Traffic Light Recognition for ADAS Systems," *2022 2nd International Mobile, Intelligent, and Ubiquitous Computing Conference (MIUCC)*, Cairo, Egypt, 2022, pp. 225-229, doi: 10.1109/MIUCC55081.2022.9781682.

[9] D. Tian, C. Zhang, X. Duan and X. Wang, "An Automatic Car Accident Detection Method Based on Cooperative Vehicle Infrastructure Systems," in *IEEE Access*, vol. 7, pp. 127453-127463, 2019, doi: 10.1109/ACCESS.2019.2939532.

[10] G. Tzedakis, E. Tzamali, E. G. Spanakis, M. Antonakakis, M. Zervakis and V. Sakkalis, "Comparing YOLO-based Detectors for Pedestrian and Car Detection in Aerial Static Video: An Evaluation of Generalization Capacity and Performance," *2023 IEEE International Conference on Imaging Systems and Techniques (IST)*, Copenhagen, Denmark, 2023, pp. 1-5, doi: 10.1109/IST59124.2023.10355688.

[11] K. R. Akshatha, S. Biswas, A. K. Karunakar and B. Satish Shenoy, "Anchored versus Anchorless Detector for Car Detection in Aerial Imagery," *2021 2nd Global Conference for Advancement in Technology (GCAT)*, Bangalore, India, 2021, pp. 1-6, doi: 10.1109/GCAT52182.2021.9587621.

[12] M. A, S. Malayil, M. K.P, M. Binshad, M. R. K.V and M. Kandanath, "Deep Learning-based Auto Accident Detection and Alert System for Vehicles," *2023 International Conference on Innovations in Engineering and Technology (ICIET)*, Muvattupuzha, India, 2023, pp. 1-5, doi: 10.1109/ICIET57285.2023.10220752.

[13] U. N. Nisha and G. Ranjani, "Deep Learning Based Night Time Vehicle Detection for Autonomous Cars using Generative Adversarial Network," *2022 International Conference on Augmented Intelligence and Sustainable Systems (ICAISS)*, Trichy, India, 2022, pp. 336-341, doi: 10.1109/ICAISS55157.2022.10010725.

[14] S. C. Kalkan and O. K. Sahingoz, "In-Vehicle Intrusion Detection System on Controller Area Network with Machine Learning Models," *2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT)*, Kharagpur, India, 2020, pp. 1-6, doi: 10.1109/ICCCNT49239.2020.9225442.