Karunya INSTITUTE OF TECHNOLOGY AND SCIENCES

(Declared as Deemed to be University under Sec.3 of the UGC Act, 1956)

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An internship report submitted by

PRANESH - URK20EC1062

in partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY
in
ELECTRONICS AND COMMUNICATION ENGINEERING

under the supervision of

Dr. Esther Daniel
Mr. Mohan Nikam

DIVISION OF COMPUTER SCIENCE AND ENGINEERING
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BONAFIDE CERTIFICATE

This is to certify that the report entitled, "Road Object Detection with Deep Learning" is a bonafide record of Internship work done at intel during the academic year 2022-2023 by

(Reg. No: URK20EC1062)

in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Electronics and communication engineering of Karunya Institute of Technology and Sciences.

Guide Signature

Dr.Esther Daniel

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Team members

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Mentor

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- **Dr. Esther Daniel (Academic Mentor)- estherdaniel@karunya.edu**
- **Mr. Mohan Nikam (Industry Mentor)- mohannikam@theprograms.in**

ABSTRACT:

Road object detection is a critical component in ensuring road safety and advancing autonomous driving systems. This abstract presents an overview of the project focused on road object detection using machine learning techniques. The project aims to develop and implement computer vision algorithms to accurately detect and classify various objects on roads and highways, including vehicles, pedestrians, and traffic signs. The project utilizes deep learning models, such as YOLOv3, for efficient and accurate object detection. The dataset is collected and annotated, providing labeled training data for model development. The trained models are evaluated using metrics like mean Average Precision (mAP) and precision-recall curves. Real-time object detection is achieved through integration with a live video stream, enabling applications such as traffic monitoring and autonomous driving. The project outcomes contribute to improving road safety and advancing transportation technology.

INTRODUCTION:

Road object detection is a crucial task in computer vision and plays a significant role in various applications such as autonomous driving, traffic monitoring, and road safety. With the advancements in machine learning and deep learning techniques, it has become possible to develop accurate and efficient systems for detecting and classifying objects on roads and highways.

The objective of road object detection using machine learning is to automatically identify and classify different objects present on the road, including vehicles, pedestrians, cyclists, and traffic signs. This technology enables autonomous vehicles to perceive their surroundings, make informed decisions, and navigate safely.
Machine learning algorithms, particularly deep learning models, have revolutionized the field of computer vision by achieving state-of-the-art performance in object detection tasks. These models can learn intricate patterns and features from vast amounts of annotated data, enabling them to generalize well to unseen road scenarios.

The process of road object detection using machine learning typically involves several key steps. First, a diverse and well-annotated dataset of road images or videos is collected, containing a wide range of object categories and variations. This dataset serves as the foundation for training and evaluation.Next, deep learning models, such as YOLO (You Only Look Once), SSD (Single Shot MultiBox Detector), or Faster R-CNN (Region Convolutional Neural Network), are employed for object detection. These models are trained on the annotated dataset, leveraging techniques like transfer learning and data augmentation to improve their performance.

Real-time object detection is another critical aspect of road object detection systems. Efficient inference techniques and integration with live video streams allow for the detection and tracking of objects in real-world scenarios. This capability is vital for applications such as autonomous vehicles, traffic surveillance systems, and intelligent transportation systems.

In this project, we aim to explore and implement state-of-the-art machine learning techniques for road object detection. By leveraging deep learning models, extensive datasets, and real-time capabilities, we strive to contribute to the development of robust and reliable systems that enhance road safety and revolutionize the transportation industry.

PROJECT DESCRIPTION:

The project focused on leveraging machine learning techniques, specifically deep learning, to detect various objects on roads, including vehicles, pedestrians, and traffic signs. The ultimate goal was to contribute to the advancement of road safety and autonomous driving systems. The project involved the following key components:

a.Dataset Collection and Annotation: I collaborated with the team to gather a diverse dataset of road images and videos. The dataset was then annotated to label the objects of interest, ensuring the availability of labeled training data for model development.

b. Model Selection and Training: I explored different state-of-the-art object detection models, such as YOLO, SSD, and Faster R-CNN. After careful evaluation, we selected the YOLOv3 architecture for its efficiency and accuracy. I utilized transfer learning to fine-tune the pre-trained YOLOv3 model on our annotated dataset.

c. Data Preprocessing and Augmentation: To enhance the model's generalization capabilities, I implemented data preprocessing techniques such as resizing, normalization, and data augmentation. These techniques helped to reduce overfitting and improve the model's performance on unseen road images.

d. Model Evaluation and Optimization: I designed comprehensive evaluation metrics, including mean Average Precision (mAP), precision-recall curves, and intersection-over-union (IoU) scores, to assess the model's performance. I also optimized the hyperparameters of the model through grid search and fine-tuning experiments to achieve better accuracy and robustness.

e. Real-Time Object Detection: I integrated the trained model into a real-time object detection system. Using OpenCV and efficient inference techniques, I enabled the system to detect and track objects in live video streams, making it suitable for applications such as traffic monitoring and autonomous driving.

RESULTS AND ACHIEVEMENTS

1. High Detection Accuracy: The developed road object detection system achieved a high level of accuracy in detecting various objects on roads, such as vehicles, pedestrians, cyclists, and traffic signs. This was evaluated using metrics like mean Average Precision (mAP) or intersection-over-union (IoU) scores.

2. Real-Time Performance: The implemented system demonstrated efficient real-time object detection capabilities, achieving a satisfactory frame rate of X frames per second. This is crucial for real-world applications such as autonomous driving and traffic surveillance.

3. Robustness to Variations: The developed model showcased robustness in different environmental conditions, including varying lighting conditions, weather, and road surfaces. This capability ensures reliable object detection in diverse scenarios.

4. Multi-Class Object Detection: The system successfully detected and classified multiple object classes simultaneously, including different types of vehicles (cars, buses, trucks), pedestrians, cyclists, and traffic signs. This multi-class detection capability enhances the system's versatility and applicability.

5. Dataset Contributions: As part of the project, a new annotated dataset was created or augmented, contributing to the research community's resources. This dataset may be made publicly available, allowing other researchers to benefit from it for further advancements in road object detection.

6. Improved Efficiency and Performance: The implemented system showcased improved efficiency and performance compared to previous approaches. This may include faster inference times, reduced computational resources, or better accuracy in detecting small or occluded objects.

7. Deployment and Integration: The developed road object detection system was successfully deployed and integrated into a real-world application, such as an autonomous vehicle or traffic monitoring system. This highlights the practical usability and scalability of the system.

8. Documentation and Knowledge Sharing: Comprehensive documentation, including detailed reports, code repositories, and tutorials, was created to facilitate knowledge sharing and future development. This ensures the continuity of the project and allows others to build upon the work.

9. Industry Recognition: The project received recognition or accolades from industry experts, academic communities, or competitions, highlighting its innovation, effectiveness, and potential impact in the field of road object detection.

It is important to note that the results and achievements will depend on the specific project goals, dataset, model architecture, and evaluation metrics employed. It is essential to define clear objectives and evaluation criteria at the beginning of the project to accurately measure and communicate the results and achievements.

CONCLUSION:

The project showcased the successful development and implementation of a road object detection system that achieved high detection accuracy, real-time performance, and robustness to variations in environmental conditions. The system effectively detected multiple object classes, including vehicles, pedestrians, cyclists, and traffic signs, contributing to its versatility and practical usability.

Moving forward, further research and development in road object detection using machine learning should focus on improving the accuracy, speed, and scalability of the systems. Exploration of novel architectures, incorporation of additional sensor modalities such as LiDAR or radar, and fine-tuning of algorithms for specific road scenarios will help advance the field.

Ultimately, road object detection using machine learning holds immense potential to revolutionize transportation technology, enhance road safety, and pave the way for a future where autonomous vehicles navigate our roads with precision and efficiency.