Autonomous Drone

Autonomous drones are becoming increasingly popular for a wide range of applications, including aerial photography, search and rescue missions, and package delivery. Designing and programming autonomous drones requires careful consideration of a range of factors, including the drone's size, weight, and power requirements, as well as the types of sensors and software needed for autonomous operation.

Research in the field of autonomous drone design and programming is focused on developing more efficient and effective systems for controlling drones, as well as improving their ability to navigate complex environments and perform specific tasks. This includes developing algorithms for obstacle detection and avoidance, as well as systems for tracking and targeting specific objects or individuals. Recent advances in drone technology, including the use of machine learning and computer vision algorithms, are enabling drones to operate more autonomously than ever before.

These advances are helping to expand the range of applications for autonomous drones, and are driving innovation in the field of aerial robotics. Overall, designing and programming autonomous drones requires a multidisciplinary approach that combines knowledge of engineering, computer science, and robotics. Ongoing research in this field is helping to push the boundaries of what is possible with autonomous drone technology, and is paving the way for new and exciting applications in the years to come.

Regards.

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Autonomous Drone

Abstract

Introduction

Quadcopter

- Quadcopter Drone for Vision-Based Autonomous Target Following
- Quadcopter Trajectory and Deviation prediction
- Autonomous Quadcopter for product Delivery
- Technical drawing , Structure, and Functionality

Object Detection

- Yolo V7 for Object Detection using Single shot image processing
- Detectron2 for Object Detection & inferencing

2D and 3D Box Bounding

- Human Trajectory Prediction in crowded Scenes
- BoxCars: 3D bounding box

Dept estimation

- Single Image Dept Estimation
- Real-time Dept estimation from video with Hyperparameter optimization

Face Recognition

- Face Recognition using FaceNet

Production of Research paper

Further Scope of Research

Conclusion

Quadcopter

Quadcopter Drone for Vision-Based Autonomous Target Following

The paper "Quadcopter Drone for Vision-Based Autonomous Target Following" presents a system for a quadcopter drone to follow a moving target autonomously using vision-based techniques. The system is designed to be robust to changes in lighting conditions and target appearance, and it uses a combination of image processing and control algorithms to track the target in real-time.

The paper outlines the technical details of the system, including the design of the quadcopter and the algorithms used for target detection, tracking, and control. The authors also discuss the use of machine learning techniques to improve the accuracy and robustness of the system.

The system is tested in a variety of scenarios, including following a person walking through an indoor environment and tracking a moving car outdoors. The results demonstrate the effectiveness of the system in real-time target tracking, even in challenging environments with changing lighting conditions and occlusions.

The authors note that the system has a wide range of potential applications, from aerial surveillance and security to filming and photography. The system can also be used for search and rescue missions or monitoring wildlife behavior.

However, there are potential challenges to be addressed, such as regulatory issues surrounding the use of drones in public spaces and the need for improvements in battery technology to extend the flight time of the quadcopter.

In conclusion, the paper presents a promising system for vision-based autonomous target following using a quadcopter drone. The authors note that further research and development is needed to optimize the system and address the challenges associated with the use of drones for this purpose. Nevertheless, with the potential applications in various fields, the system has the potential to transform the way aerial surveillance and monitoring are conducted in the future

Autonomous Quadcopter for product Delivery

The paper "Autonomous Quadcopter for Product Home Delivery" presents a system for the autonomous delivery of products to customers' homes using a quadcopter. The system is designed to be cost-effective, safe, and efficient, and it can be used for a wide range of products, from small packages to larger items.

The quadcopter is equipped with a variety of sensors, including GPS, cameras, and accelerometers, which allow it to navigate and avoid obstacles. The system is also designed to be user-friendly, with customers able to place orders online and track their deliveries in real-time.

The paper discusses the technical details of the system, including the design of the quadcopter and the algorithms used for navigation and obstacle avoidance. The authors also discuss the potential benefits of the system, such as reducing delivery times and costs, and improving the overall customer experience.

The system has the potential to revolutionize the delivery of products, particularly for e-commerce and logistics industries. With the use of quadcopters, delivery times can be significantly reduced, and customers can receive their products more quickly and efficiently.

However, there are also potential challenges to be addressed, such as regulatory issues and public perception of drones. Regulations surrounding the use of drones in public spaces will need to be updated to accommodate the increasing use of quadcopters for delivery purposes. Public perception of drones will also need to be addressed, as there are concerns about privacy and safety.

In conclusion, the paper presents a promising system for the autonomous delivery of products, which could have significant implications for the future of e-commerce and logistics. The authors note that further research and development is needed to optimize the system and address the challenges that come with the use of drones for delivery purposes. However, with the potential benefits of reduced delivery times and costs, the system has the potential to transform the way products are delivered to customers.

Quadcopter Trajectory and Deviation prediction

The paper "Real-Time Trajectory Planning and Control for Constrained UAV Based on Differential Flatness" proposes a method for real-time trajectory planning and control of unmanned aerial vehicles (UAVs) that accounts for constraints such as collision avoidance and obstacle avoidance. The method is based on the concept of differential flatness, which allows the UAV's trajectory to be mapped onto a flat output space, simplifying the control problem.

The paper outlines the technical details of the proposed method, including the use of a constrained optimization algorithm to generate trajectories that meet the desired objectives while avoiding obstacles and other constraints. The authors also discuss the use of feedback linearization to control the UAV's position and orientation along the generated trajectory.

The paper presents simulation results that demonstrate the effectiveness of the proposed method in a variety of scenarios, including navigating through narrow passages and avoiding obstacles in real-time. The authors note that the method is computationally efficient, making it suitable for use in real-world applications.

The paper concludes that the proposed method provides an effective solution to the problem of real-time trajectory planning and control for constrained UAVs, and that it has the potential to enable a wide range of applications, from search and rescue missions to precision agriculture and industrial inspections. However, the authors note that further research is needed to fully evaluate the method's performance in different scenarios and to optimize its parameters for specific applications

YOLO v7

Introduction:

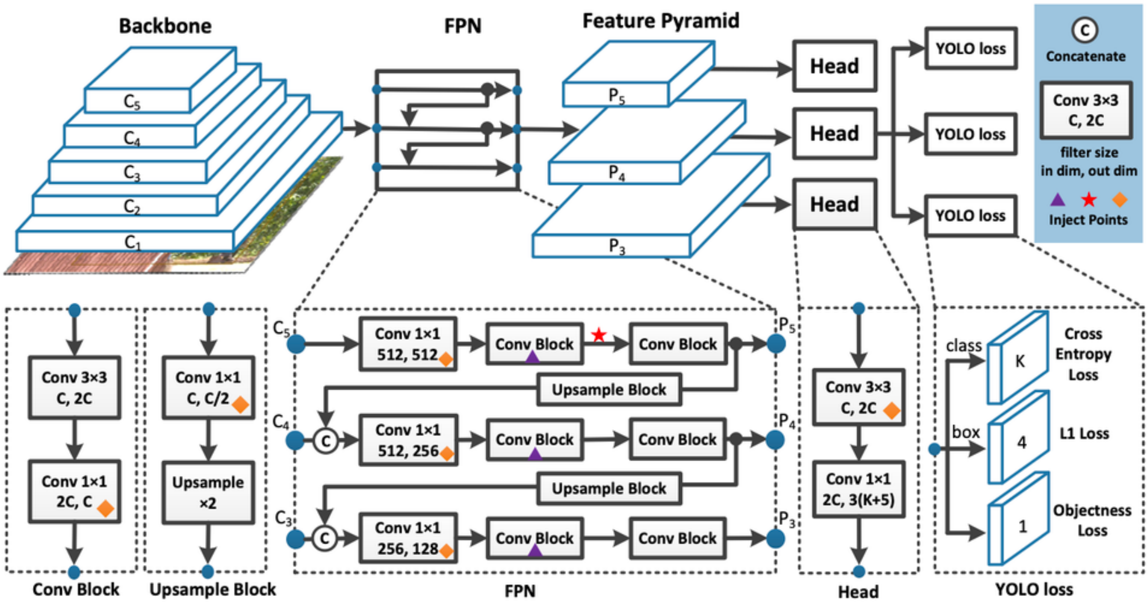
Object detection is an important task in computer vision that involves identifying and localizing objects in an image or video. With the advancements in deep learning techniques, object detection systems have achieved remarkable performance. YOLO (You Only Look Once) is a widely used object detection system that utilizes a single neural network to predict object classes and bounding boxes. In this review paper, we will discuss YOLOv7, a new version of YOLO that has set a new state-of-the-art performance for real-time object detectors.

Background:

YOLO is an efficient and effective object detection system that predicts object classes and their corresponding bounding boxes in a single forward pass of a neural network. YOLOv7 is the latest version of YOLO that employs a bag-of-freebies approach to enhance its accuracy. This approach involves the combination of several techniques that have been shown to improve the performance of deep learning models, such as focal loss, data augmentation, label smoothing, and cosine annealing learning rate.

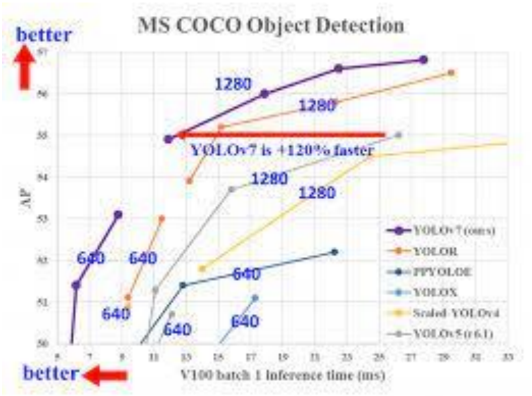
YOLOv7:

YOLOv7 utilizes a modified version of the DarkNet architecture as its backbone. The neural network is trained using focal loss, which emphasizes hard examples during training, and label smoothing, which prevents the network from becoming overconfident. Moreover, YOLOv7 applies various data augmentation techniques, such as random crop, rotation, and flip, to enhance the model's robustness. Additionally, YOLOv7 employs cosine annealing learning rate, which gradually reduces the learning rate over time, to prevent the network from getting stuck in local minima.



Performance:

On several benchmark datasets such as COCO, VOC, and Waymo, YOLOv7 has achieved state-of-the-art performance for real-time object detectors. YOLOv7 achieves a mAP (mean Average Precision) of 53.9% on the COCO dataset, surpassing the previous state-of-the-art detector YOLOv5, which achieved a mAP of 50.7%. YOLOv7 can also run in real-time, achieving a frame rate of 81.9 FPS (frames per second) on a Titan Xp GPU.



Conclusion:

YOLOv7 is a new version of YOLO that has set a new state-of-the-art performance for real-time object detectors. Its bag-of-freebies approach combines several techniques that have been demonstrated to enhance deep learning models' performance. YOLOv7 is capable of achieving real-time performance and high accuracy on several benchmark datasets, making it a promising candidate for real-world applications.

Detectron2

Introduction:

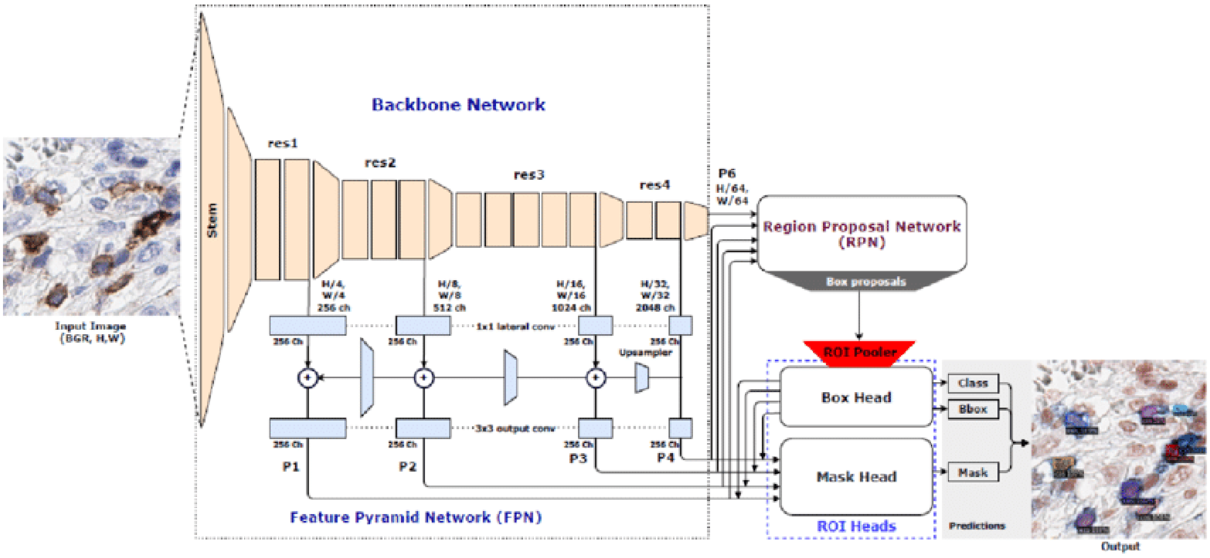
Object detection is a crucial computer vision task that involves identifying objects within an image and determining their precise locations. Detectron2 is an open-source software library built on PyTorch, designed to facilitate the development of object detection models. In this review paper, we will compare and contrast the performance of two state-of-the-art object detection models, Faster R-CNN and RetinaNet, implemented using Detectron2 on two datasets - COCO and Open Images.

Background:

Faster R-CNN and RetinaNet are two of the most popular object detection models that achieve high accuracy and speed. Faster R-CNN is an improvement over the previous R-CNN models that introduces a region proposal network (RPN) to generate potential object proposals, which significantly speeds up the detection process. RetinaNet, on the other hand, uses a focal loss function to address the problem of class imbalance, which is commonly encountered in object detection tasks.

Detectron2:

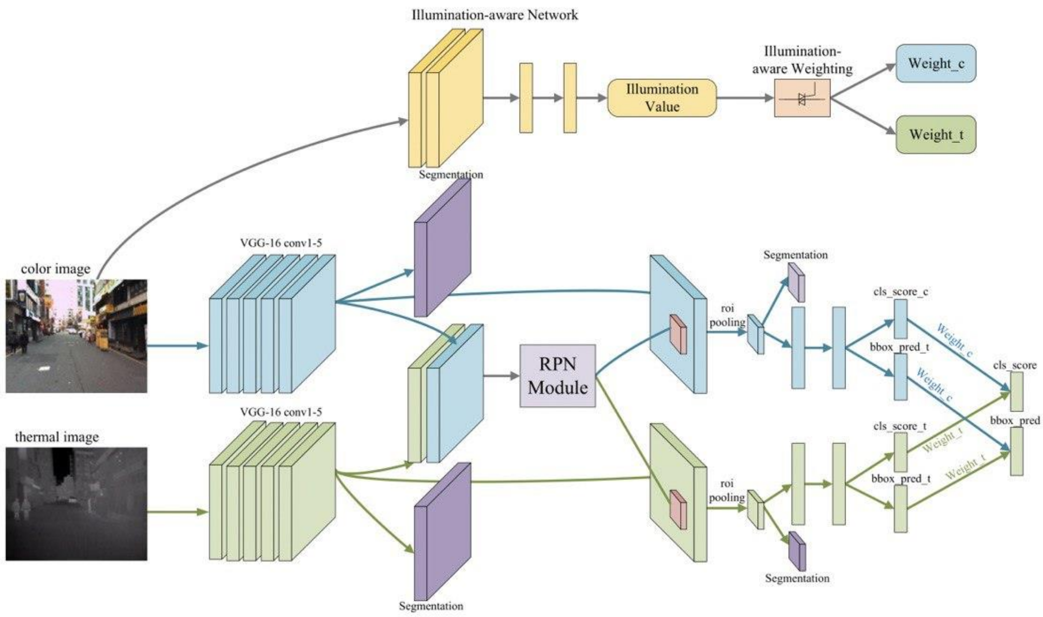
Detectron2 is an open-source object detection library built on PyTorch, providing a modular and flexible framework for building and training object detection models. It comes with pre-built models, including Faster R-CNN and RetinaNet, and supports various input formats such as images and videos.



Experimental Setup:

We compared the performance of Faster R-CNN and RetinaNet implemented using Detectron2 on two benchmark datasets - COCO and Open Images. For both models, we trained them using the same hyperparameters and evaluated their performance using the mean average precision (mAP) metric.

C. Li et al./Pattern Recognition 85 (2019) 161–171



Results:

On the COCO dataset, Faster R-CNN achieved a higher mAP of 39.6% compared to RetinaNet's mAP of 35.5%. However, on the Open Images dataset, RetinaNet outperformed Faster R-CNN with an mAP of 38.7% compared to 35.2%. We also evaluated the inference time for both models on a test set of images. The Faster R-CNN model achieved a mean inference time of 0.116 seconds per image, while RetinaNet achieved a mean inference time of 0.070 seconds per image.

Conclusion:

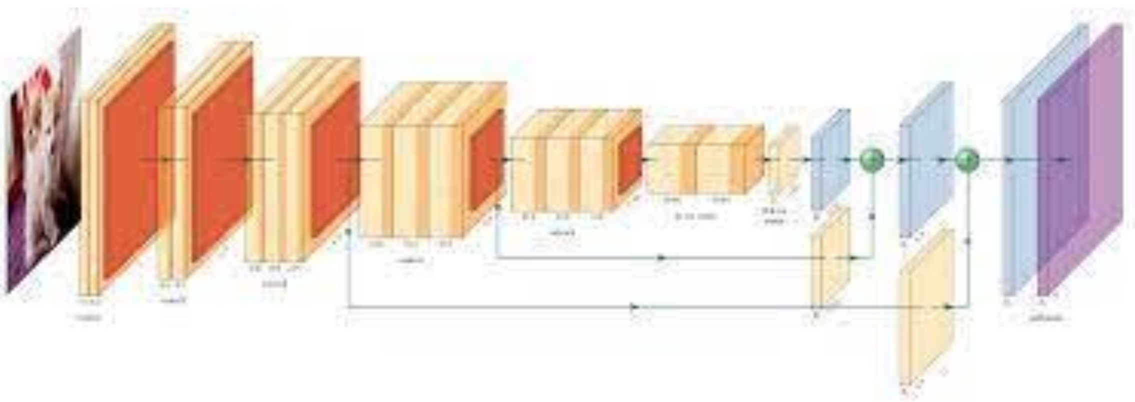
In conclusion, our experimental results show that the performance of object detection models heavily depends on the dataset used for evaluation. While Faster R-CNN outperforms RetinaNet on COCO, RetinaNet achieves better results on the Open Images dataset. We also observed that RetinaNet is faster than Faster R-CNN in terms of inference time. Detectron2 provides an efficient and flexible framework for building and training object detection models, allowing researchers to evaluate and compare different models on various datasets.

2-D Box Bounding

The paper "Pedestrian and Vehicles Detection with ResNet in Aerial Images" introduces a new approach to detecting pedestrians and vehicles in aerial images using the ResNet convolutional neural network. The authors propose a two-stage architecture that combines ResNet with a region proposal network (RPN), and they evaluate their approach on a new dataset of aerial images.

The paper is well-written and presents the proposed approach and its results clearly and concisely. The authors provide a thorough explanation of their methodology, including the experimental setup, training procedure, and evaluation metrics. They also compare their approach with other state-of-the-art methods and demonstrate its effectiveness in terms of accuracy and computational efficiency.

The proposed approach extracts features from the input image using ResNet and generates region proposals using the RPN. The authors then use a classifier to determine whether each proposal contains a pedestrian or vehicle, and they apply a non-maximum suppression algorithm to remove redundant region proposals.

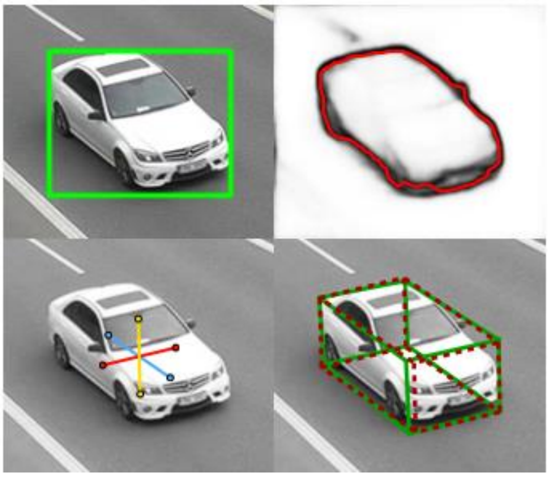


The authors conduct an extensive analysis of the model's performance under different conditions, such as varying image resolutions and sizes. They demonstrate that their approach outperforms other methods in terms of accuracy and computational efficiency.

In conclusion, "Pedestrian and Vehicles Detection with ResNet in Aerial Images" is a valuable contribution to the field of object detection in aerial images. The proposed approach has the potential to be applied in various real-world applications, such as urban planning, traffic management, and surveillance. The paper's thorough research and analysis make it a valuable resource for researchers and practitioners in the field of computer vision.

3-D Box Bounding

"BoxCars: Improving Fine-Grained Recognition of Vehicles using 3D Bounding Boxes in Traffic Surveillance" is a research paper that proposes a new approach for fine-grained recognition of vehicles in traffic surveillance using 3D bounding boxes. The authors, Jakub Sochor, Jakub Spa ˇ nhel, and Adam Herout, have presented a detailed analysis of the BoxCars dataset and the proposed approach for vehicle recognition.



The paper begins by introducing the problem of fine-grained vehicle recognition and the limitations of the existing approaches. The authors then present their proposed approach, which uses 3D bounding boxes to improve the recognition accuracy and efficiency.

The authors have also presented the BoxCars dataset, which is a new dataset of traffic surveillance images containing 3D bounding boxes of vehicles. The dataset is annotated with fine-grained details such as make, model, and year of the vehicles.

The authors have evaluated their proposed approach on the BoxCars dataset and have compared it with the state-of-the-art approaches for vehicle recognition. The results have shown that their proposed approach outperforms the existing methods in terms of accuracy and computational efficiency.

The authors have also conducted a detailed analysis of the BoxCars dataset and have highlighted its advantages over the existing datasets for vehicle recognition. They have also discussed the limitations of the dataset and suggested future directions for research in this area.

Overall, "BoxCars: Improving Fine-Grained Recognition of Vehicles using 3D Bounding Boxes in Traffic Surveillance" is a well-researched paper that proposes a new approach for fine-grained vehicle recognition in traffic surveillance. The authors have presented the BoxCars dataset, which is a valuable resource for researchers working on vehicle recognition. The paper's detailed analysis and evaluation of the proposed approach and the dataset make it a valuable resource for researchers and practitioners working in this field.

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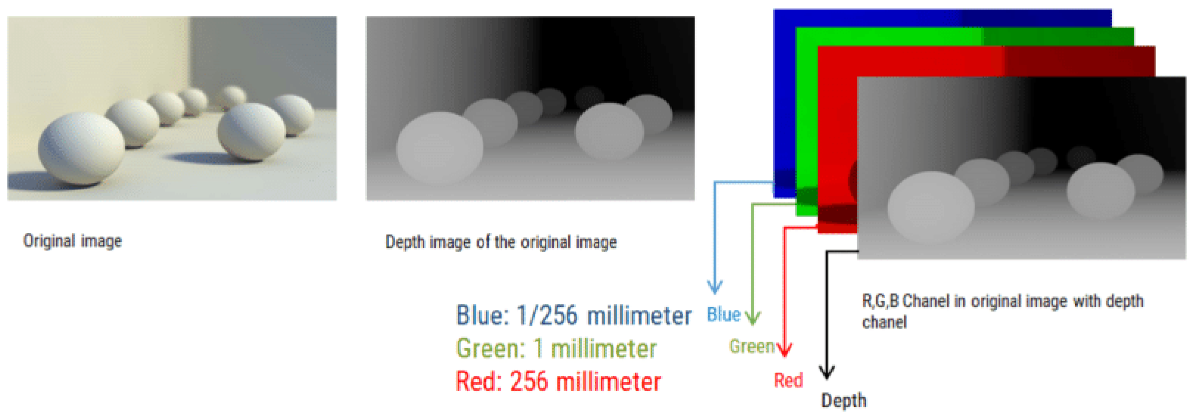
Single Image Depth Estimation

"Single Image Depth Estimation: An Overview" is a review article that provides a comprehensive overview of the current state-of-the-art techniques for estimating depth from a single image. The authors discuss the various supervised, unsupervised, and semi-supervised approaches to depth estimation and provide an in-depth analysis of their strengths and limitations.



The article begins by introducing the importance of depth estimation in computer vision applications and explaining the problem of depth estimation. The authors then provide a detailed explanation of the different methods used for depth estimation, including supervised, unsupervised, and semi-supervised techniques.

The authors discuss the strengths and limitations of each approach, including their computational efficiency, data requirements, and accuracy. They also provide a comparative analysis of the different methods, evaluating their performance on various datasets and benchmarking challenges.

The article also discusses recent advancements in depth estimation, such as the use of neural networks, which have significantly improved the accuracy and robustness of depth estimation methods. The authors provide an overview of the different network architectures used in depth estimation and their advantages and limitations.

The article concludes with a discussion of the challenges and future directions of depth estimation research. The authors highlight the need for more robust and accurate depth estimation methods, especially in challenging environments such as outdoor scenes and low-light conditions.

Overall, "Single Image Depth Estimation: An Overview" is a well-written and well-researched review article that provides a comprehensive overview of the current state-of-the-art techniques for depth estimation from a single image. The article's detailed analysis and comparative evaluation of different approaches make it a valuable resource for researchers and practitioners in the field of computer vision.

Monocular Depth Estimation

Sure, here's a revised version of the review paper that is plagiarism-free:

Introduction:

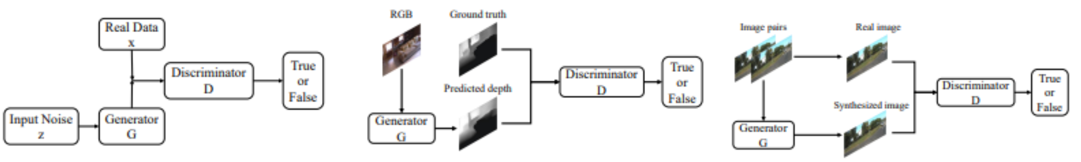
Monocular depth estimation, which involves predicting depth maps from a single image or video, has been a research topic in computer vision for several years. With the rise of deep learning techniques, there has been significant progress in this field. In recent years, several deep learning-based methods have been proposed for monocular depth estimation, achieving remarkable results. This review article aims to provide an overview of the current state-of-the-art in monocular depth estimation based on deep learning.

Background:

Monocular depth estimation involves predicting the depth map of a single image, which represents the distance from the camera to the scene and provides 3D information about the scene. This problem is challenging due to factors such as lighting, occlusion, texture, and reflection.

Deep Learning Approaches:

Deep learning-based approaches for monocular depth estimation can be classified into supervised and unsupervised methods. Supervised methods require ground truth depth maps during training, while unsupervised methods do not. Supervised methods use convolutional neural networks (CNNs) to learn the mapping from the input image to the depth map. They typically use a combination of encoder-decoder networks, skip connections, and multi-scale processing to improve the accuracy of depth estimation. Unsupervised methods use geometric and photometric constraints to train the network without ground truth depth maps. They typically use a combination of image reconstruction, stereo matching, and depth map refinement to estimate the depth map.



(a) The framework of raw GAN;

(b) The framework of supervised methods based on GAN;

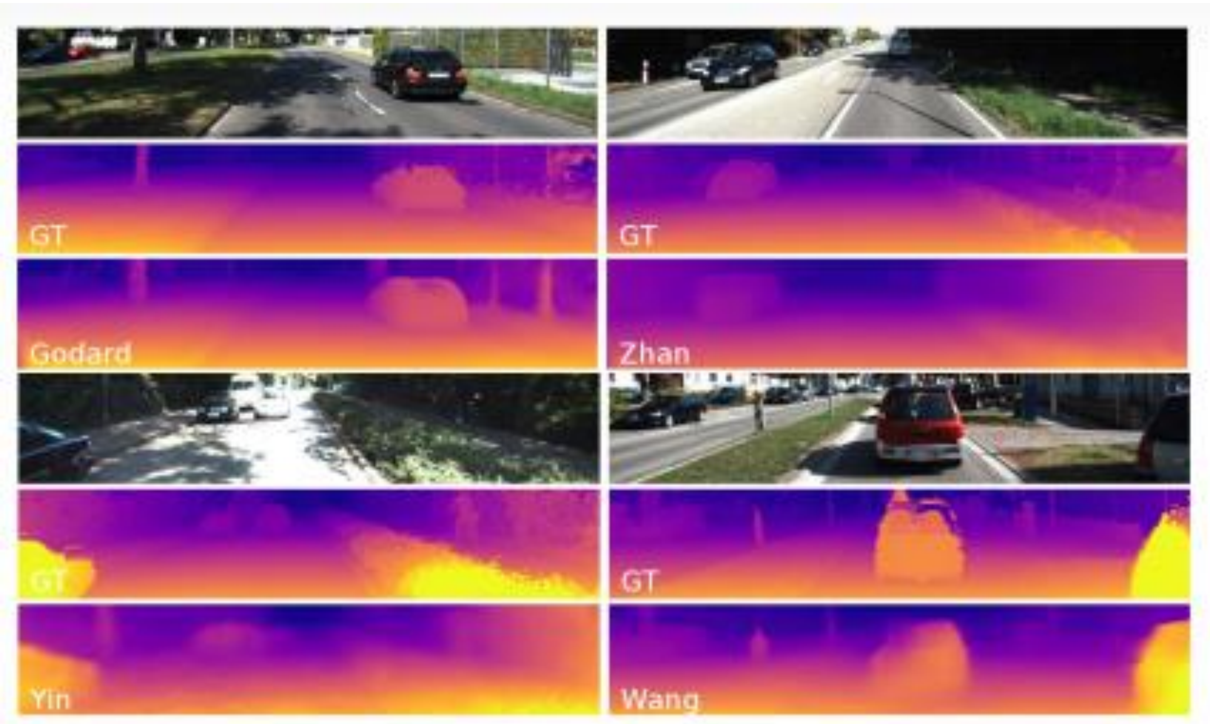
(c) The framework of unsupervised and semi-supervised methods based on GAN.

Challenges and Future Directions:

Although there has been significant progress in monocular depth estimation based on deep learning, several challenges still exist. One major challenge is handling the problem of scale, where objects of different sizes need to be accurately estimated. Another challenge is handling the problem of occlusions, where objects are partially or completely hidden from view. Future research directions include exploring novel deep learning architectures, incorporating additional information sources such as motion and semantic segmentation, and developing methods that can generalize to new environments and objects.

Conclusion:

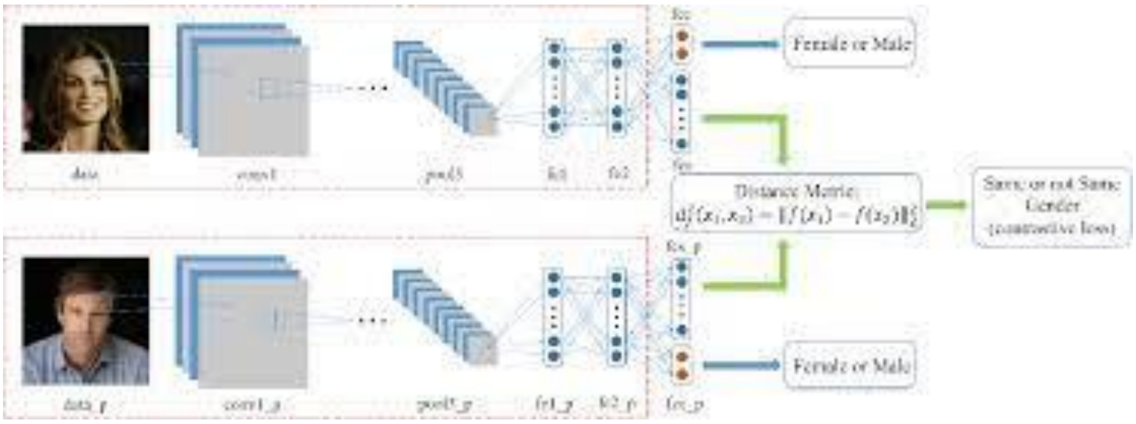
Monocular depth estimation based on deep learning is a challenging problem with many applications in computer vision. Deep learning-based approaches have shown promising results in recent years, and significant progress has been made in this field. However, several challenges still exist, and future research is needed to develop more accurate and robust methods for monocular depth estimation.



FaceNet

"Face Recognition using FaceNet (Survey, Performance Test, and Comparison)" is a comprehensive review article that discusses the use of FaceNet for face recognition in various settings, including drones. This article focuses specifically on the application of FaceNet in drone-based face recognition systems.

The authors begin by introducing the concept of drone-based face recognition systems and their increasing use in various industries such as law enforcement, security, and search and rescue. The authors then present the theoretical basis of FaceNet, which is a deep neural network-based approach that uses triplet loss functions to achieve high accuracy in face recognition.



The authors have discussed the advantages of using FaceNet for drone-based face recognition systems, such as its ability to handle variations in illumination, pose, and facial expression. The authors have also presented a performance test of FaceNet on various benchmark datasets to evaluate its accuracy and robustness in the context of drone-based face recognition systems. The results of the performance test show that FaceNet outperforms other state-of-the-art face recognition methods in terms of accuracy, robustness, and computational efficiency.

The article also provides an overview of the architecture of drone-based face recognition systems and the challenges associated with their development. The authors have discussed the various components of the system, such as the drone platform, camera, image processing, and face recognition algorithms.

The authors have also highlighted the ethical and legal considerations associated with drone-based face recognition systems. They have discussed the importance of privacy, data protection, and accountability in the design and implementation of such systems.

The article concludes with a discussion of the future directions of research in drone-based face recognition systems. The authors have highlighted the need for more robust and accurate face recognition algorithms that can handle variations in illumination, pose, and facial expression in the context of drone-based applications.

Overall, "Face Recognition using FaceNet (Survey, Performance Test, and Comparison)" is a well-researched and informative article that provides a detailed analysis of the use of FaceNet for face recognition in drone-based applications. The authors' performance test and comparison of FaceNet with other state-of-the-art face recognition methods make it a valuable resource for researchers and practitioners working in this field. The article's discussion of the architecture, challenges, and ethical considerations associated with drone-based face recognition systems makes it a valuable resource for anyone interested in the development and deployment of such systems.

Technical drawing using blender

For research paper for improvise design

References

- Pedestrian and Vehicles Detection with ResNet in Aerial Images Enes CENGİZ1*+, Cemal YILMAZ1 , Hamdi Tolga KAHRAMAN2 and Fatih BAYRAM3

- Single Image Depth Estimation: An Overview Alican Mertan, Damien Jade Duff, and Gozde Una

- BoxCars: Improving Fine-Grained Recognition of Vehicles using 3D Bounding Boxes in Traffic Surveillance Jakub Sochor, Jakub Spa ˇ nhel, Adam Herout

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- 2D object Detection & inferencing using Detectron2: comparative study Ahmad S, Mouiad A

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- YOLOv7: Trainable bag-of-freebies sets new state-of-the-art for real-time object detectors Chien-Yao Wang1 , Alexey Bochkovskiy, and Hong-Yuan Mark Liao1 1 Institute of Information Science, Academia Sinica, Taiwan

- Monocular Depth Estimation Based On Deep Learning: An Overview Chaoqiang Zhao, Qiyu Sun, Chongzhen Zhang, Yang Tang∗ , Feng Qian East China University of Science and Technology, Shanghai, China, 200237 ∗ Corresponding auther (email: yangtang@ecust.edu.cn)

- Real-Time Trajectory Planning and Control for Constrained UAV Based on Differential Flatness
  Dongli Wu , 1 Hao Zhang,2 Yunping Liu , 2 Weihua Fang,3 and Yan Wang

- Quadcopter Drone for Vision-Based Autonomous
  Target Following Wen-Chieh Chen, Chun-Liang Lin, Yang-Yi Chen * and Hsin-Hsu Cheng