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Pedestrian Safety in Semi-Autonomous Vehicles - A Study

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ABSTRACT

This paper studies work related to Autonomous vehicles, they have the ability to sense their surroundings and navigate on their own. To perceive their surroundings and choose the best course of action, they use technologies like artificial intelligence, computer vision, LIDAR, and GPS. The success of autonomous vehicles lies on the level of safety that it provides to the commuters as well as general public. Unlike static objects pedestrians are active agents with complex characteristics. The study asses recent development on pedestrian detection and tracking in autonomous vehicle, various open datasets, Comparison with LIDAR and Computer vision, Robot Operating system integration, traffic sign recognition etc. The papers conclusion looks into the overall improvement in accuracy, handling scenarios with pedestrians and will provide valuable insights on enhancing pedestrian detection and safety in autonomous vehicles

Keywords - Autonomous Vehicles, City_persons, Computer Vision, LIDAR

1. INTRODUCTION

Semi-autonomous vehicles are becoming increasingly popular, and their use is expected to rise in the coming years. However, there are safety concerns that need to be addressed, particularly with regard to pedestrian safety. This paper aims to discuss various safety measures that can be implemented to ensure pedestrian safety in semi-autonomous vehicles. Recent developments in the field of pedestrian safety in semi-autonomous vehicles have shown that machine learning algorithms can be used to improve pedestrian detection and identification [1][2] . These algorithms can be trained to analyze a variety of different scenarios and environments, and can therefore improve the accuracy of pedestrian detection, especially in complex urban environments where there may be multiple pedestrians and other obstacles to contend with. In addition to machine learning algorithms, researchers have also begun exploring the use of artificial intelligence (AI) technologies to further improve pedestrian safety in semi-autonomous vehicles. By continuing to explore these technologies and their potential applications in semi-autonomous vehicles, researchers can help to improve the safety of both pedestrians and drivers on the roads, and pave the way for a safer and more efficient transportation system in the future. The paper discusses various aspects of pedestrian detection, datasets and algorithms used and compares their results with base benchmarks etc.

2. RELATED WORKS

The papers studies are related to various algorithms used for pedestrian detection and ethical frameworks related to self driving cars.

2.1 Works related to self driving car technologies and ethics

The paper [3] describes 5 main ethical frameworks with respect to self driving cars those are

1. Utilitarianism is a moral philosophy that seeks to maximize overall happiness or utility. In the context of self-driving cars, utilitarianism would prioritize actions that minimize harm and maximize benefits for the greatest number of people.

2. Deontology is a moral theory that emphasizes the importance of following moral rules or duties. In the context of self-driving cars, deontology would prioritize actions that adhere to a set of moral principles or rules, regardless of the potential consequences.

3. Relativism is the belief that morality is subjective and varies depending on the individual or cultural context. In the context of self-driving cars, relativism would suggest that moral decisions should be based on the specific circumstances and cultural values of the society in which the cars are operating.

4. Absolutism (monism) is the belief that there are universal moral principles that apply to all situations, regardless of context. In the context of self-driving cars, absolutism would prioritize actions that adhere to a set of universal moral principles, regardless of the potential consequences or cultural context.

5. Pluralism is the belief that there are multiple valid moral perspectives, and that different perspectives may be appropriate in different contexts. In the context of self-driving cars, pluralism would suggest that different moral principles may be relevant depending on the specific circumstances and cultural context in which the cars are operating

2.2 Work related to pedestrian detection

Z. Cai and N. Vasconcelos [4] discuss Cascade R-CNN: By adding a cascade of detectors with increasing precision, this framework enhances the quality of object identification by building on the well-known Faster R-CNN architecture. Traditional object detection frameworks, according to the paper's authors, have large false positive rates, which can produce unreliable results. This problem is addressed by the Cascade R-CNN framework, which adds a succession of detectors, each with a higher level of precision than the one before it. Each detector's output is utilized to improve the input for the following one in the cascade. The paper also suggests a number of further enhancements to the Faster R-CNN architecture, including a new feature alignment module that enhances the alignment between feature maps and object suggestions, the anchor scales and aspect ratios are adjusted to better match the sizes and shapes of the objects in the training data using a dynamic anchor assignment technique. The Cascade R-CNN framework achieves state-of-the-art performance in terms of both accuracy and speed, exceeding existing state-of-the-art object detection approaches, according to experimental results on a number of benchmark datasets. The Cascade R-CNN architecture, according to the authors, is a promising method for accurate object detection in practical applications.

Paper [5] introduces a new dataset for the detection of pedestrians in urban settings. The study makes the case that the variety of pedestrian appearances and occlusions experienced in real-world scenarios is not adequately represented by the existing datasets for pedestrian detection. The CityPersons dataset, which comprises over 19,000 pedestrian annotations in photos taken in various cities throughout the globe, is presented by the paper's authors as a solution to this problem. The dataset includes annotations for several parameters like gender, age, and dress style and is diverse in terms of pedestrian appearances, occlusions, and sizes. In addition, the article suggests a brand-new evaluation criteria for pedestrian identification that considers how challenging it is to identify pedestrians in busy and obscured environments. The CityPersons dataset offers a more demanding and varied benchmark for pedestrian detection than previous datasets, according to experimental results, and the suggested evaluation metric offers a more complete measure of detection performance. The CityPersons dataset, according to the authors, can progress the creation of more reliable and accurate pedestrian recognition algorithms for urban settings.

Shao, Shuai & Zhao, Zijian [6] discusses CrowdHuman which is a benchmark dataset created for testing and training item detection algorithms in crowded environments. One of the largest databases of its sort, it includes more than 15,000 photos and more than 470,000 annotated human occurrences. Detailed variables like occlusion, truncation, and crowd density are included in the annotations in addition to bounding boxes, making it possible to evaluate the accuracy and robustness of the detection algorithms. The paper also suggests a brand-new evaluation criteria dubbed "AP@50," which assesses detection efficiency in dense crowds. By contrasting the performance of various state-of-the-art detection algorithms on CrowdHuman and other benchmark datasets, the authors show the value of the dataset and the suggested metric.

The paper [7] discusses Euro_City_persons A benchmark dataset created for object detection in urban

environments is the EuroCityPersons Dataset. With a focus on pedestrian recognition, the collection comprises of more than 47,000 annotated photos of metropolitan settings taken by cameras mounted on moving cars. The annotations allow for the evaluation of detection algorithms in a variety of difficult circumstances because they include bounding boxes and specific features like occlusion, truncation, and orientation. The research suggests a brand-new evaluation metric called "MR-O" that assesses the detection miss rate at various occlusion levels. By contrasting the results of various state-of-the-art detection algorithms on EuroCityPersons and other benchmark datasets, the authors show the value of the dataset and the suggested metric. The publicly accessible dataset can be utilized for testing and training.

The paper [8] discusses F2DNet a deep learning model. The model is built on the focused loss function, which emphasizes the value of challenging training instances and enhances the model's performance on uncommon and challenging examples. The F2DNet design is made up of a detection head that anticipates the bounding boxes and class labels of pedestrians in the input image and a feature extraction backbone. The "RoI pooling with feature guidance" method that the authors suggest enhances the precision of bounding box regression and lowers the incidence of false positives. The model delivers state-of-the-art performance in terms of speed and accuracy after being trained and assessed on numerous benchmark datasets, including EuroCity People and CityPersons.

The paper [9] discusses A method for pedestrian detection using the RetinaNet architecture on the Wider Pedestrian Detection Challenge. Using a small portion of the Wider Pedestrian dataset for domain adaptation, the authors fine-tune the RetinaNet model pre-trained on the COCO dataset. They also suggest a number of data augmentation methods to enhance the model's functionality. For the Wider Pedestrian Detection Challenge dataset, the suggested method performs at the cutting edge with an average precision of 84.8%. The study illustrates RetinaNet's efficacy in detecting pedestrians as well as the significance of domain adaptation in enhancing the generalizability of computer vision models.

3. COMPARISON OF VARIOUS ALGORITHMS AND DATASETS WITH RESPECT TO PEDESTRIAN DETECTION

Dataset: The COCO dataset, which also includes other object classes, is used by Cascade RCNN. Both CityPersons and EuroCityPersons, with CityPersons gathered in urban regions and EuroCityPersons collected in European cities, concentrate particularly on pedestrian detection. In its research on pedestrian detection, F2DNet makes use of the Caltech Pedestrian dataset. The WIDER dataset, which has a dedicated subset for pedestrian detection and includes a range of object classifications, is used by Wider Pedestrian Detection.

Algorithm: Cascade RCNN is a two-stage object identification system that use a final classifier in addition to a series of region proposal networks (RPNs) to find objects. A single-stage identification method with a fully convolutional network is used by CityPersons and EuroCityPersons (FCN). In order to identify anomalies, F2DNet combines a discriminative model with specially created features. A single-stage detection approach with a convolutional neural network (CNN) and a proposal network is used by Wider Pedestrian Detection.

4. RESULTS

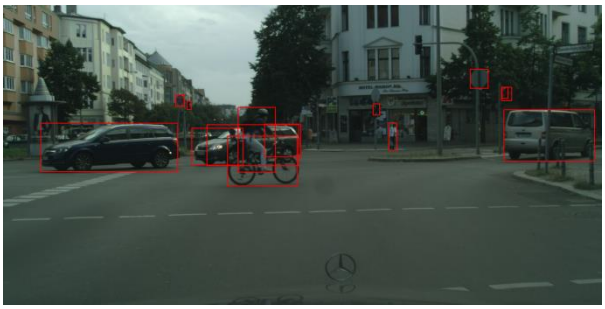

Fig 1: Cityscapes-citypersons detections [5]

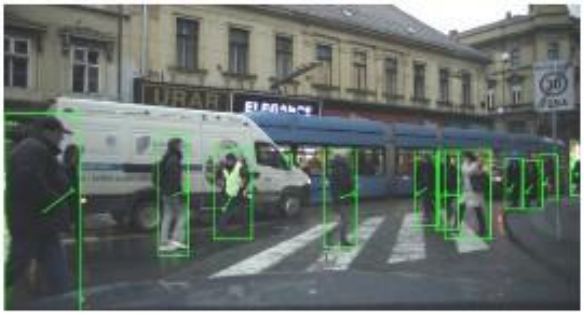

Fig 2: EuroCityPersons detections [7]

Fig 3: Crowd Human detection [6]

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5. CONCLUSION

By comparing various Algorithms and datasets specifically designed for pedestrian detection we conclude that F2Dnet with CityPersons effective for pedestrian detection. Since CityPersons is a dataset created especially for pedestrian recognition in urban settings, it gives a good picture of the difficulties encountered there. For CityPersons, F2DNet produced state-of-the-art results after being tuned for this dataset. F2DNet employs hand-crafted features, which might be useful when the amount of training data is constrained. The accuracy of detection can be increased by using hand-crafted features to capture significant facets of pedestrian appearance and surroundings. Model for discriminating between pedestrians and non-pedestrian objects: F2DNet employs a discriminative model. As a result, detection accuracy can be increased overall and false positive detection's can be decreased. F2DNet has a high computing efficiency and can process images in real time. This makes it appropriate for pedestrian detection

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