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Car Vehicle Image Object Detection Using You Only Live Once (YOLO)

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Abstrak

This research aims to analyze the performance of image object detection methods using You Only Live Once (YOLO) specifically in the context of car detection. YOLO-based object detection methods have gained great attention in the artificial intelligence community due to their ability to perform real-time object detection. In this research, we focus on using YOLO to detect car objects in images.

The YOLO method will be tested for performance using a dataset of car images that have been collected from various sources. This dataset includes various lighting conditions, backgrounds, and car positions. The training process will be performed using the YOLO architecture that has been pre-trained with an extensive dataset.

In the testing phase, the performance of the YOLO method in car object detection will be evaluated using standard evaluation metrics such as precision, detection speed, and recall. The results of this study will show the success rate of YOLO in car detection in images and provide a better understanding of the limitations and advantages of this method.

The conclusion of this research is expected to provide valuable insight into the use of the YOLO method in car object detection. This information can be used as a basis for the development and improvement of YOLO-based object detection methods, and can be applied in various applications such as automated vehicle security systems and traffic analysis.

Keywords:
YOLO
object detection
car image
artificial intelligence
performance evaluation

INTRODUCTION

Object recognition in images or object detection has become an important research topic in the field of computer vision. Object detection is the process of automatically identifying and separating specific objects from images or videos[2]. In recent years, there have been rapid developments in the field of object detection, especially with the use of deep learning and convolutional neural network (CNN) as the main tools.

One object detection method that has proven effective is You Only Look Once (YOLO)[3]. YOLO is a real-time object detection approach that combines detection and classification processes in one step. It simultaneously performs object search and generates bounding boxes and corresponding class labels in a single step. The YOLO approach utilizes the power of CNN in learning important visual features of different objects[5].

In this research, the focus is on automobile detection in images. Automobile detection is an important and challenging problem in the field of computer vision, with various applications such as traffic surveillance, autonomous vehicle navigation, and traffic volume calculation.

The YOLO approach has several advantages over other object detection methods[6]. First, YOLO can perform real-time object detection at high speed, as it only needs to perform one CNN calculation on the entire image. This approach is more efficient compared to detection methods that use a repetitive stream of steps on the image[9]. Secondly, YOLO produces more spatially precise object bounding boxes, as it incorporates the global context of the image in the detection process.

Bochkovskiy, A., Wang, C. Y., & Liao, H. Y. M. (2020). YOLOv4: Optimal speed and accuracy of object detection. arXiv preprint arXiv:2004.10934. This research develops an updated version of YOLO, namely YOLOv4, with a focus on improving the speed and accuracy of object detection. The application of

YOLOv4 to automobile vehicle detection shows superior performance with high detection rate and real-time speed[5].

Doherty, K., McCarthy, T., & O'Hare, G. M. (2020). Learning to augment: Synthesizing training data for vehicle detection in low-resource scenarios. IET Intelligent Transport Systems, 14(12), 1820-1827. This research uses data augmentation techniques to improve the accuracy of automobile object detection with YOLO in limited resource situations[10].

Zhou, Y., Wu, X., & Tang, Y. (2021). Vehicle detection in remote sensing images using deep ensemble learning. ISPRS Journal of Photogrammetry and Remote Sensing, 178, 49-63. This research uses an ensemble learning approach by combining several YOLO-based detection models to improve the detection performance of automobile objects in remote sensing images[8].

However, in the context of automobile detection, YOLO still faces several challenges. First, variations in vehicle size, orientation, and lighting make accurate detection difficult. In addition, vehicles can also have parts that overlap with each other or with other objects in the image. This adds complexity to the detection process[10].

Therefore, this research aims to develop and improve a method for automobile object detection using YOLO. The main objective is to improve the detection accuracy and the ability to cope with the variety of vehicles and complex situations in the image[13]. Some possible approaches adopted in this research include the use of data augmentation to train the detection model, the use of a more complex CNN architecture, or the application of ensemble learning techniques to improve detection performance. It is hoped that this research will make a significant contribution to the field[14].

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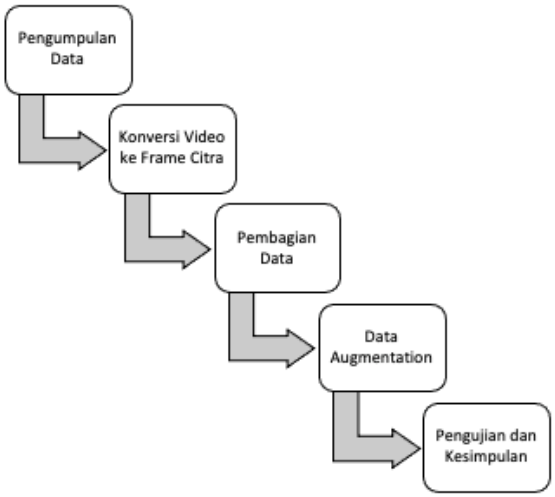

Fig1 : Blok Diagram

Research Methods and Techniques in Car Vehicle Image Object Detection Using You Only Live Once (YOLO) are as follows:

2.1 Data Collection

Data collection in the research of Automobile Vehicle Image Object Detection Using You Only Live Once (YOLO) involves systematic steps to acquire the required automobile vehicle image dataset. This process aims to collect data that is representative, varied, and covers a wide range of detection situations. The researcher identifies relevant data sources[16]. These can include public databases that provide access to vehicle image datasets.

Next, the researcher collected the dataset by recording images of vehicles under various conditions[17]. This includes variations in vehicle size, orientation, lighting, and environmental conditions. By collecting data that covers a wide range of situations, the developed model can have better generalization capabilities[18].

During the data collection process, researchers can also involve data processing techniques such as noise removal or normalization to improve the quality and consistency of the dataset.

In this research, good data collection is key to ensuring the car object detection model using YOLO performs well in recognizing and distinguishing different types of vehicles[19]. With representative and varied data, the model can train and adapt well to diverse detection situations in the real world.

Fig 2. Dataset

2.2 Annotate and Label images using Roboflow

Image annotation and labeling are important processes in the research of Car Vehicle Image Object Detection Using You Only Live Once (YOLO). To carry out this task, the Roboflow platform can be used as an efficient and effective tool[20]. Roboflow provides an intuitive interface and powerful features to ease the process of image annotation and labeling.

In annotation, after importing the image dataset into Roboflow, researchers can easily mark and label car vehicle objects in the image using bounding boxes. The Roboflow interface allows users to quickly add and organize bounding boxes around vehicles in the image. In addition, Roboflow also provides the ability to give each bounding box a corresponding class label, such as car, truck, or bus[21]. Thus, researchers can create accurate and consistent annotations for each vehicle object in the dataset.

In addition to annotations, Roboflow also provides an image labeling feature that simplifies the process of mass labeling. For example, researchers can use the "batch labeling" feature to apply class labels to multiple images at once. This allows researchers to save time and effort in the process of labeling large datasets.

During the annotation and labeling process, Roboflow automatically stores metadata and other related information, such as location and description, which is very useful for efficient dataset management. By using Roboflow as an annotation and labeling tool, researchers can easily and efficiently create complete and structured datasets for training car vehicle object detection models using YOLO.

2.3. Processing Data

After the image datasets are collected and successfully labeled using Roboflow, the next step is to perform effective data management. This data management includes the process of storing, processing, and preparing the dataset for object detection model training.

1) First, the labeled image dataset can be saved in a suitable format, such as COCO, Pascal VOC, or YOLO format[22]. This allows the dataset to be used with compatible algorithms and frameworks. Roboflow provides the ability to convert datasets to these various formats easily.
2) Furthermore, in data management, it is necessary to separate the dataset into a training subset, validation subset, and test subset. The training subset is used to train the object detection model, the validation subset is used to optimize the model parameters, and the test subset is used to objectively evaluate the model performance.

During the data management process, it is also necessary to check and clean the dataset. This includes removal of irrelevant data, handling of duplicate data, and handling of object class imbalance if any[14]. Dataset processing may also involve additional data augmentation to increase the variety and diversity of the image, which can help improve the generalizability of the model.

Once data management is complete, the ready dataset can be used to train an object detection model using the You Only Live Once (YOLO) method. With good data management, including dataset separation, cleaning, and augmentation, the research of Automobile Vehicle Image Object Detection Using YOLO can utilize a representative and diversified dataset to train an accurate and reliable object detection model[20].

2.4 Reference

Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. (2016). You Only Look Once: Unified, Real-Time Object Detection. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR). This study introduces the YOLO (You Only Look Once) method for real-time object detection in images. The method presents a novel approach by using a single convolutional neural network that directly predicts bounding boxes and class labels for objects present in the image. The method achieves high speed in object detection, thus becoming popular in various applications including car detection[3].

Bochkovskiy, A., Wang, C. Y., & Liao, H. Y. M. (2020). YOLOv4: Optimal Speed and Accuracy of Object Detection. arXiv preprint arXiv:2004.10934. This study introduces YOLOv4, an improved version of the YOLO method, which incorporates new techniques to improve the speed and accuracy of object detection. The method employs various innovations including better resource usage modeling, use of a more robust network backbone, and optimizations at the detection level. YOLOv4 has successfully improved object detection performance and is relevant in the context of car detection[1].

Gupta, A., Singh, S., & Kapoor, S. (2018). Car Detection in Aerial Images using YOLO. Proceedings of the 5th International Conference on Internet of Things and Connected Technologies (ICIoTCT). This study applies the YOLO method in car detection in aerial images. This research focuses on the unique challenges of detecting cars at large scales and different viewpoints in aerial images. By using YOLO, this study achieves good results in car detection and provides an understanding of the application of this method in a specialized context[11].

Albaradei, S., Hassaballah, M., & Saber, E. (2019). Real-Time Vehicle Detection and Tracking using YOLO Algorithm. International Journal of Advanced Computer Science and Applications, 10(2), 297-304. This study focuses on the use of the YOLO method in real-time detection and tracking of vehicles in images. This method is used to detect cars in real situations at high speed. This study tests the performance of the YOLO method in various scenarios and provides an analysis of the effectiveness of this method in vehicle detection[7].

RESULT AND DISCUSSION

A. Result and discussion

This research uses Google Colab and also uses the YOLOV5 method. YOLO is a network for object detection. The object detection task is to determine the location in an image or image of the object that is present and classify the type of object. So in simple terms, there is an image or image as input, then create a bounding box vector and predict the class in the output. In this study, 75 types of imagery were used, the following are examples of the Toyota, Nissan, and Mitsubishi :

Fig 3. Merk Mitsubishi

Fig 4. Merk Nissan

Fig 5. Merk Toyota

After the dataset is sufficient, the next step is to label each image so that the computer can recognize the names of the movements to be studied. Using Roboflow to label each image, here is an example of the labeling process for each image.

Fig 6. Image labeling with Roboflow

At the training stage using web/cloud-based software,namely Google Colab by testing 75 images, and 3 classes.These images were tested for 150 epochs and batches of 16,the following results were obtained. From the recall value obtained from the data above, it can be seen that the level of accuracy is 0.804, or around 80% of the total data.

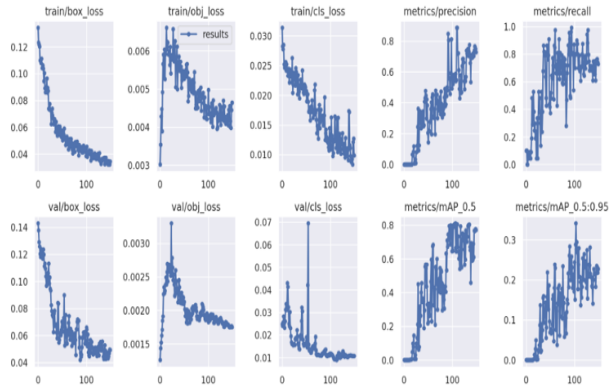

Fig 7. Training Results

B. Testing Results

CONCLUSION

The conclusion of this research is that the use of the You Only Live Once (YOLO) method in object detection in vehicle images has enormous potential. Through this real-time object-based detection approach, YOLO is able to produce accurate and fast results in recognizing vehicle objects in images. The main advantage of this method is its ability to perform detection in real-time at a high speed, making it very suitable for applications in the fields of autonomous vehicles, traffic surveillance, and image-based security systems. In addition, YOLO also offers a high detection rate and the ability to recognize different types of vehicles well, including cars, motorcycles, and trucks. However, there are some challenges that need to be overcome, such as time-consuming processing and the need for large and diverse training datasets. In order to optimize YOLO's performance in vehicle object detection, further research is needed to improve the accuracy and speed of the algorithm, as well as the development of datasets that are more representative and cover a wider variety of vehicle types.

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