Object Detection Modeling with Thermal Imaging

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Abstract

With the recent interest in automated modes of transportation, safety is an ever-growing concern as more and more fatal incidents occur. This recent development has led to an increasing interest in machine learning to aid in the new technology. We present CAPY (Captured Analysis of Photos with YOLO)- a new machine-learning approach to converting and analyzing thermal images and detecting objects within thermal pictures and live feeds. This approach is more efficient, accurate, and robust than the current models for thermal detection while cutting out the need for an expensive thermal camera.

Introduction

Object detection AI has recently become a popular topic in the machine learning community. Many individuals have worked together to create different models to analyze colorized images and videos to find objects. Popular examples of such models include YOLO, RetinaNet, and RCNN. With the increased interest in self-driving transportation, it would make sense for object detection to be extended for the use cases of automated transportation. The biggest obstacle in this is night-time driving. Thermal cameras can help to detect objects at night, but they aren't as cost and maintenance efficient for widespread use. Our team set out to allow an AI model to detect objects using images that look like thermal images, but are not taken by a thermal imaging camera.

Data Collection

We collected our data from Teledyne FLIR, a thermography company that has released a data set of thermal images and videos associated with varying driving conditions. We were able to access our dataset of more than 26442 frames through a direct download of the content provided by the company. These frames were fully annotated to display 15 categories: person, bike, car, motorcycle, bus, train, truck, traffic light, fire hydrant, street sign, dog skateboard, stroller, scooter, and other vehicles. By using this dataset to train YOLOv7's default capabilities, we were able to effectively and accurately detect a multitude of object categories beyond the 15 annotated on the FLIR Dataset.

Model

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Results

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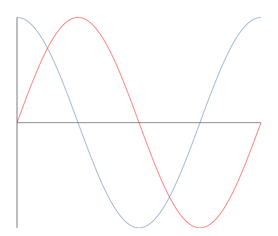

Figure 1. Another figure caption.

Analysis and Comparison

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Relevance

With the success of our model, it is understood that filtered images made to look like thermal images could be used effectively for object detection at night. However, what would be the purpose of this, considering we already have thermal cameras?

Thermal cameras tend to be an added expense for modern car manufacturers as they can not replace regular cameras. This, combined with the ease of confusion for thermal cameras make it impractical for average cars to house this hardware. Taking color images at night and filtering them into black and white images imitates thermal images and emphasises contrast in the image. AI models trained on real thermal images can use these fabricated ones to accurately detect objects noticeably better than with regular color images.

With cars at cheaper prices being able to use object detection technology at night, nights will be safer for more individuals around the world.

Future Endeavors

The quality of our model's effectiveness and accuracy was highly limited to the FLIR Dataset and is something we would like to work on in the future. This data included a variety of test cases and scenarios however, we would like to include some edge cases to make our recognition algorithm more accurate. Furthermore, we would like to add more meaningful data and features to our model in order to improve its usability in the industry. Some of these features include detection of distance between objects and the source of the video and velocity of said objects in a certain direction towards or away from the camera.

References

Wong, Kin-Yiu. "Official YOLOv7." GitHub, 12 Sept. 2022, github.com/WongKinYiu/yolov7.