Pedestrian Detection for Autonomous Vehicles

Interaction Lab Palisades Charter High School, Class of 2025

Luis Ramirez, Leticia Pinto Alva, Prof. Maja Matarić **USC Viterbi Department of Computer Science Engineering, SHINE 2023**

Motivation

USC

Viterbi

School of Engineering

K-12 STEM Center

In 2020, 7000 pedestrian deaths occurred in the United States alone [1]. In California, pedestrian deaths had a 7.7% increase from 2020 to 2021 [2]. This motivates continued research towards safe autonomous vehicles. Our project looks at optimal use of object detection used for pedestrian detection, toward use in preventing crashes in vehicles.

Object detection is a subset of supervised machine learning, which uses labeled datasets to train models that will output a classified result. Our project uses the Faster R-CNN model [3], and the Penn-Fudan Database for Pedestrian Detection and Segmentation dataset for training, validation, and testing the model Faster R-CNN.

Methods

Faster R-CNN is the model that was used to train for pedestrian detection. It is a modified version of its predecessors, region based convolutional neural network (R-CNN) and Fast R-CNN. The most effective advancement made on Fast R-CNN which caused the creation of Faster R-CNN was the implementation of Region Proposal Networks (RPN).



The metric used to evaluate our model after training, validating and testing with the Pascal database was Intersection over Union (IoU) [4] which consists of amount of overlap between the bounding box predicted by the model against the ground truth given by the database. The IoU average after 5 epochs is 85.6 and after 10 epochs is 88.6, showing an increase after every epoch.



Ex. 1) Two people detected by the model, with people in the background.



References

[1] Centers for Disease Control and Prevention. (2022, May 13). Pedestrian safety. Centers for Disease Control and Prevention. [2] Stewart, T. (2023, April). Overview of motor vehicle traffic crashes in 2021 (Report No. DOT HS 813 435). National Highway Traffic Safety Administration [3] Ren, S., He, K., Girshick, R., & Sun, J. (2016, January 6). Faster R-CNN: Towards real-time object detection with region proposal networks. arXiv.org. [4] Hofesmann, E. (2020, August 24). IOU A Better Detection Evaluation Metric. Medium.





Results



Fig 1. As the IoU average increases with every epoch the model is improving over time.





Skills Learned

- Learned Python (subsets of python) -*PyTorch* - a machine learning framework used for applications like computer vision and natural language processing.
- -Matplotlib a library used for data visualization in data analysis, scientific research, and more.
- **Exposed to Machine Learning** (subset of Machine Learning)
- -Object Detection a computer vision task that involves identifying and localizing objects of interest within an image or a video.
- **Practiced Literature review** (First Time)
- -Familiarity with various research approaches and frameworks
- -Better understanding of the limitations and challenges faced by previous studies

Advice For Future Shine Students

When getting into SHINE I had no prior experience with research or even Python, but with the help of my mentor and USC's welcoming environment I was able to adjust to the research process. So my biggest piece of advice would be to not be afraid of asking questions, access to University level information isn't an everyday occurrence.

Acknowledgements

would like to thank Professor Maja Matarić for the opportunity to conduct research in the SHINE program, and Leticia Pinto Alva for her incredible mentorship help throughout my project. I'd also like to thank the USC K-12 STEM Center for granting me the opportunity to participate in this program for no cost. My gratitude also goes out towards the SHINE Director Monica Lopez and SHINE Coordinator Marcus Gutierrez for all their guidance and helpfulness throughout these 7 weeks