Real-Time Detection of Irregularities on the Road

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Introduction

- Road traffic injuries are the leading global[1] cause of death for persons aged 5-29 years.

- Inadequate road conditions cause, approximately, 34% of all the traffic accidents in Costa Rica[2].

- Efficient prevention systems to alert drivers are needed.

- Computer vision is a rising technology that could be a possible solution to this problem.

Methodology

To create an image dataset, we used 21041 images from a repository[3,4]; additionally, we assembled and labeled 398 more images.

Table 1 Irregularities we aim to detect.

Irregularity	Abbreviation
Linear vertical crack	■ D00
Linear horizontal crack	■ D10
Alligator crack	■ D20
Pothole	■ D40

Secondly, we divided our dataset into 6 different versions to feed the Computer Vision model (object detector). We named these versions V01 to V06 (Fig. 1).
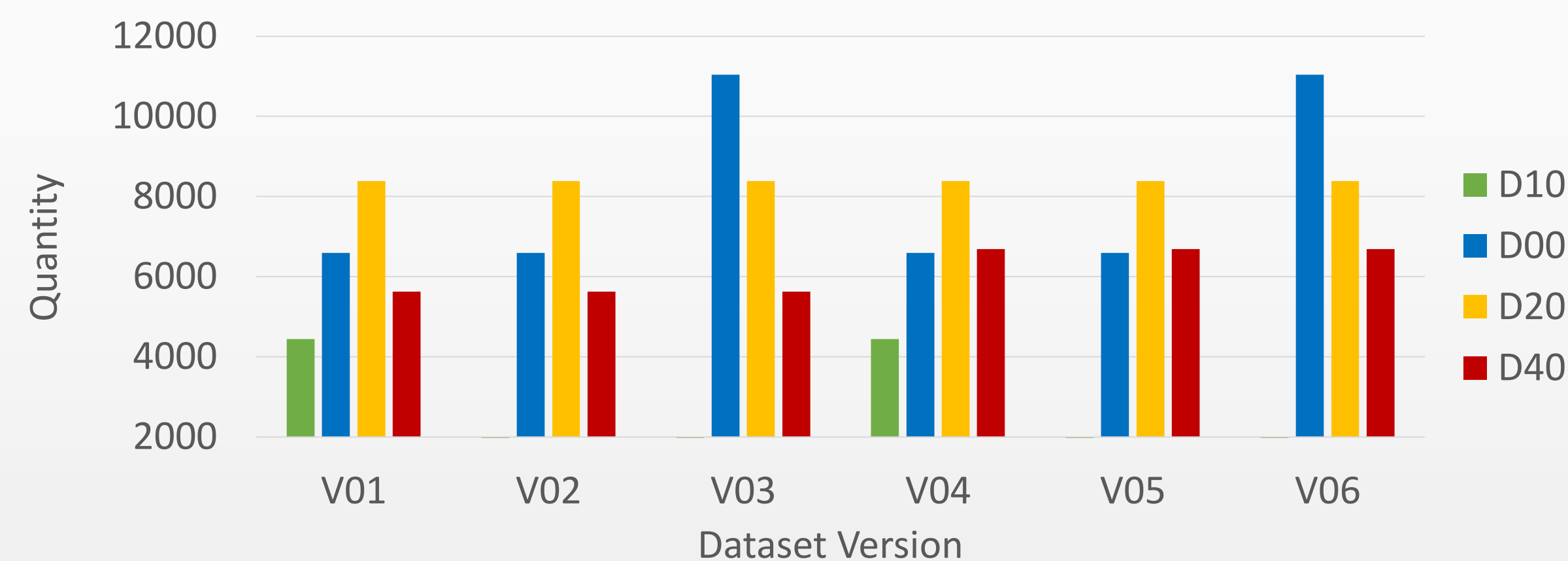

Fig. 1 Contents in each dataset version.

We used the Darknet[5] framework with YOLOv4 to train an object detector. Furthermore, we trained each model in Google Collaboratory with a hosted runtime that provided GPU use.
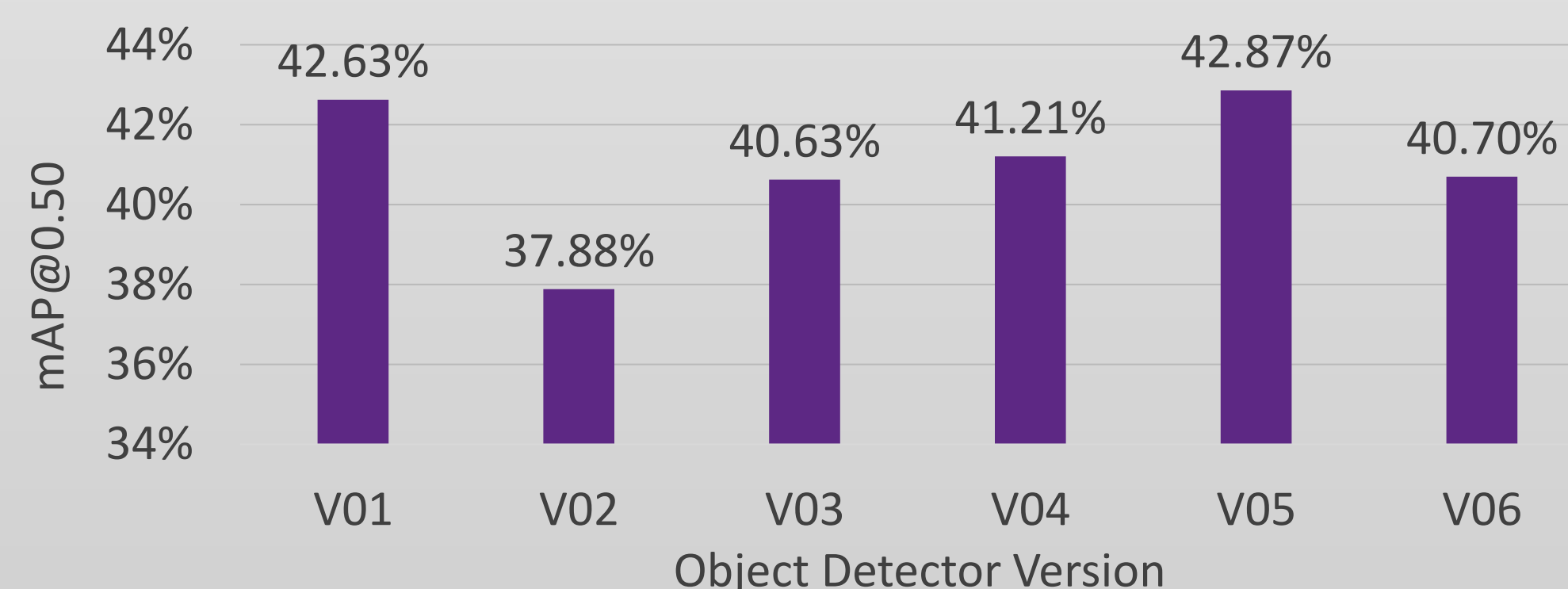
Results

Fig. 2 mAP@0.50* for each model after training.

Since the object detectors produced by V01 and V05 have very similar mAP values, we considered the confidence rate of each model and compared their average precision for analysis.

*mAP@0.50 (mean average precision) is a parameter that determines the proficiency of an object detector for the same dataset. Higher values of mAP@0.50 imply a better performance.

54.45% of times V01 was more confident in predictions than V05. The average precision of each class was higher in V01.

Fig. 3 Prediction of the V01 object detector.

Conclusion

The V01 object detector outperforms the other versions. It can effectively detect irregularities on the road in real-time.

This system can potentially be implemented as an add-on to a GPS app and share data with other users and maintenance officials, thus making travel safer and road maintenance more efficient.

References

[1] World Health Organization 2018. [Online] Available: here.

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[3] D. Arya, H. Maeda, S. K. Ghosh, D. Toshniwal, A. Mraz, T. Kashiyama y Y. Sekimoto, *Transfer Learning-based Road Damage Detection for Multiple Countries*, 2020.

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[5] A. Bochkovskiy, C.-Y. Wang y H. Liao, «YOLOv4: Optimal Speed and Accuracy of Object Detection,» *ArXiv*, vol. abs/2004.10934, 2020.

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