Gate Detection

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1 Summary

- Implementation of Yolo Object Detector [2, 1] in Python (Keras, tensorflow)
- Verification of implementation by training and testing on Pascal VOC dataset
- Training Yolo on generated gate dataset
- Evaluation of Yolo with respect to camera position

2 Set Generation

- at most 1 gate per image
- gate taken from IROS 2017 (2.5m square gate)
- background pictures from Pascal VOC dataset
- camera positions 10000 randomly samples within the following parameters:

$$\Phi \in [-\frac{\pi}{2}, \frac{\pi}{2}] \quad \Theta \in [-\frac{\pi}{2}, \frac{\pi}{2}] \quad \Psi \in [-\frac{\pi}{2}, \frac{\pi}{2}] \quad X = [-5, -15] \quad Y = [0.5, 0.5] Z = [-0.5, 0.5]$$

  where $1 \rightarrow 0.85m$
- Image format: BGR,YUV (one set each)

2.1 Training Parameters

- sample size = 60600, 60000 containing one gate, 600 containing no gate
- epochs=100 (early stop after 20), batch size=8, training size = 90%, validation size = 10%
- solver: adam, $\alpha = 0.001$, $\beta_1 = 0.9$, $\beta_2 = 0.999$

2.2 Test Set

- sample size = 1100, 1000 containing one gate, 100 containing no gate

3 Results

4 Conclusions

- Much better results with YUV format
- No real influence of angle/distance measurable

5 Next Step

- Evaluate on cases where gate is close to border
- Try to break it
- compare to other models e.g. SSD
- Test how precise bounding boxes are

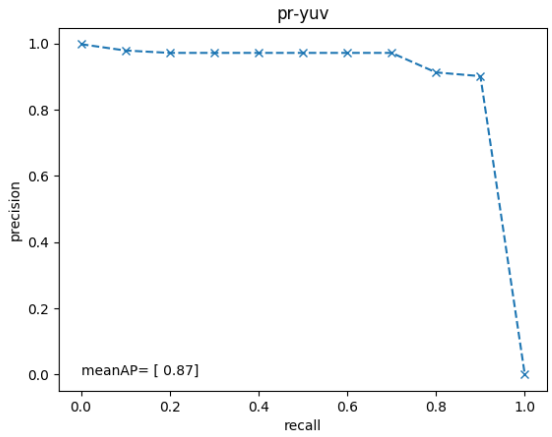

Figure 1: Yolo on YUV-set at different confidence levels. Testset size =1000

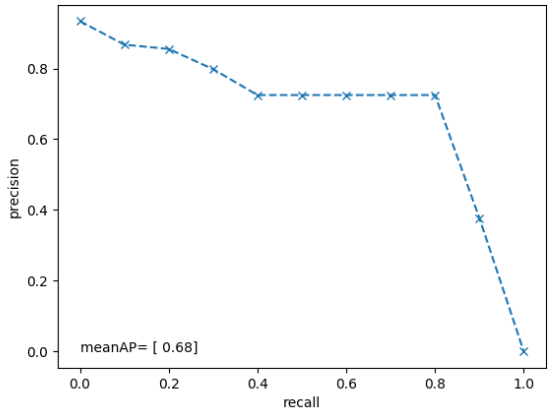

Figure 2: Yolo on BGR-set at different confidence levels. Testset size =1000

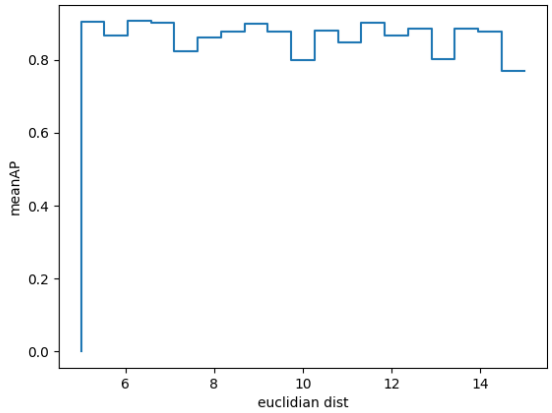

Figure 3: AP over Distance on YUV

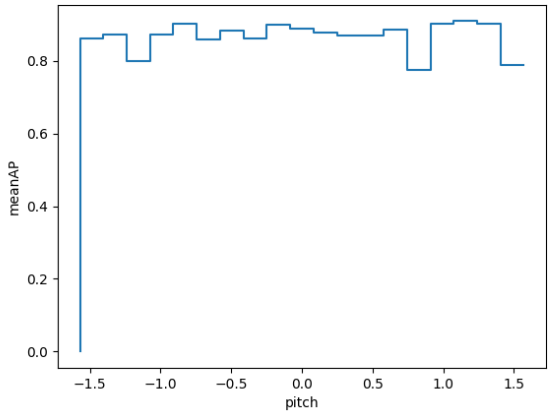

Figure 4: AP over Pitch angle on YUV

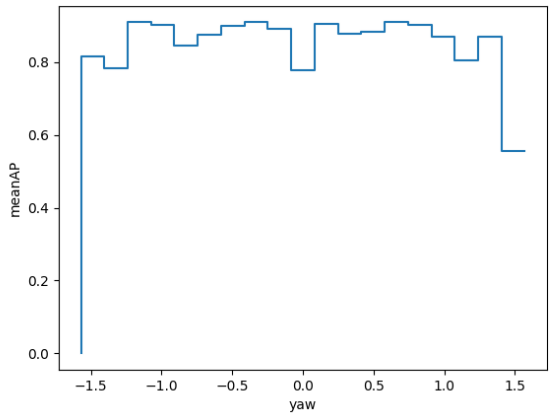

Figure 5: AP over Yaw angle on YUV

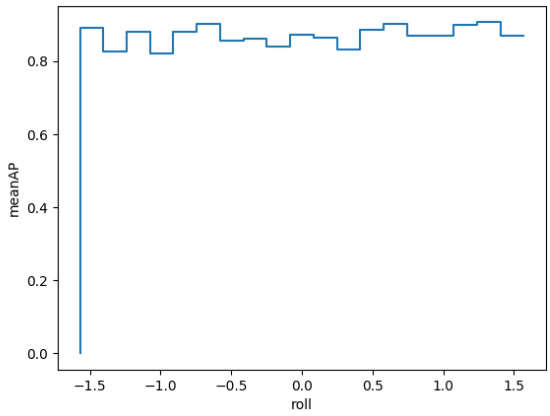

Figure 6: AP over Roll angle on YUV

References

[1] J. Redmon, S. Divvala, R. Girshick, and A. Farhadi. You Only Look Once: Unified, Real-Time Object Detection. 2015.

[2] C. Szegedy, S. Reed, P. Sermanet, V. Vanhoucke, A. Rabinovich, M. Simon, E. Rodner, J. Denzler, J. Redmon, A. Farhadi, S. Ioffe, C. Szegedy, W. Liu, D. Anguelov, D. Erhan, C. Szegedy, S. Reed, C.-y. Fu, A. C. Berg, S. Ioffe, V. Vanhoucke, A. Alemi, S. Reed, P. Sermanet, V. Vanhoucke, A. Rabinovich, J. Shlens, Z. Wojna, F. N. Iandola, S. Han, M. W. Moskewicz, K. Ashraf, W. J. Dally, K. Keutzer, K. He, X. Zhang, S. Ren, J. Sun, T. Chen, and C. Guestrin. YOLO9000: Better, Faster, Stronger. *Data Mining with Decision Trees*, 7(3):352350, 2016.