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Tugas 2
Computer Vision Lanjut
“Object Detection”

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25/571614/SPA/01154

Doktor Ilmu Komputer

Template and Target Image

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- **Template Image**
  - Figure 1 shows a single fighter jet captured from a top view.
- ***Target Image***
  - Figure 2 shows a formation of **seven identical fighter jets** flying in the sky with smoke trails.
- The goal of object detection here is to identify all occurrences of the jet (identical to the template) within the target image, utilizing the template matching algorithm.
- In template matching, the algorithm takes this small reference image and scans through the larger image to find regions that are most similar to the template.

Figure 1. Template Image

Figure 2. Target Image

Object Detection Process Flow

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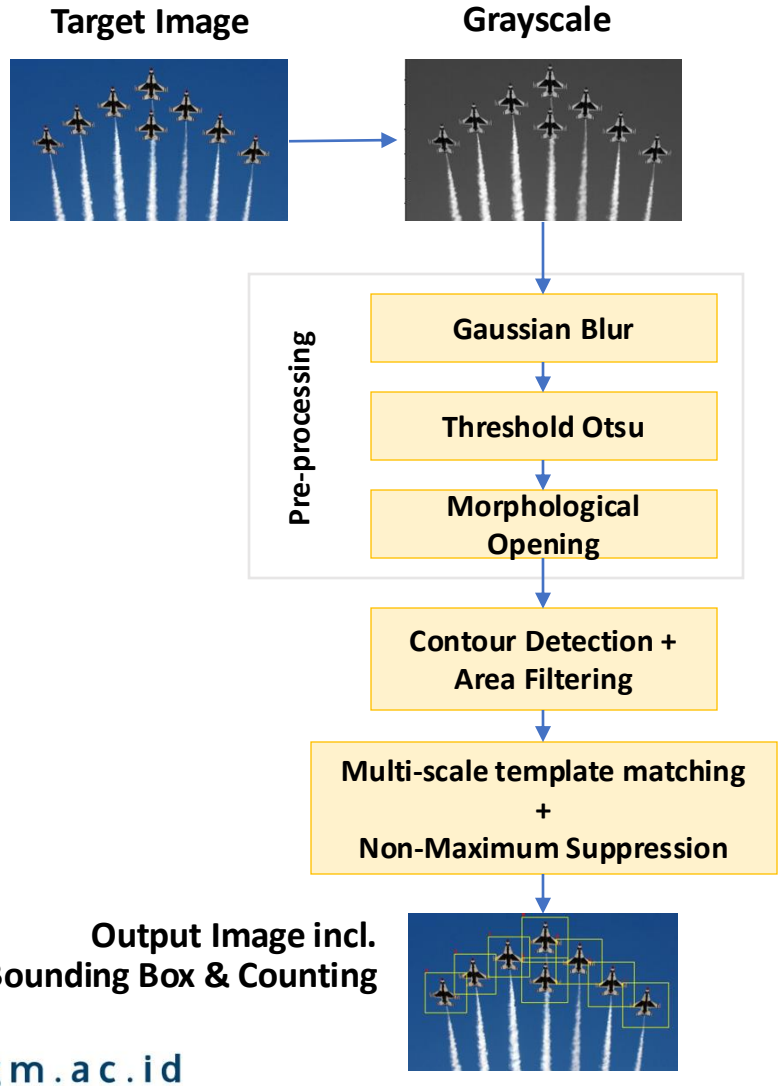

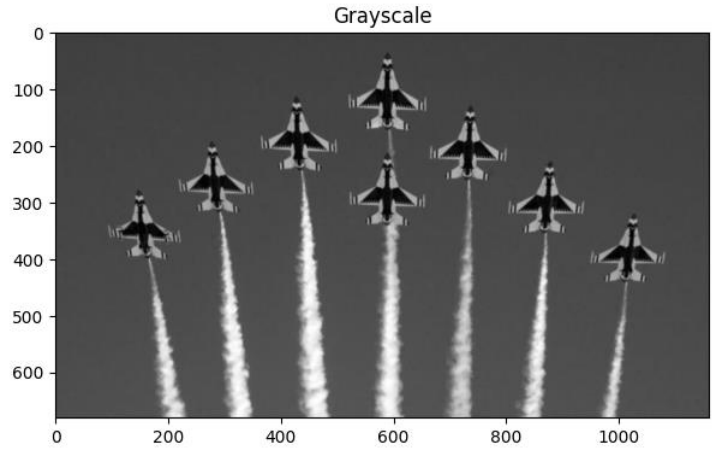

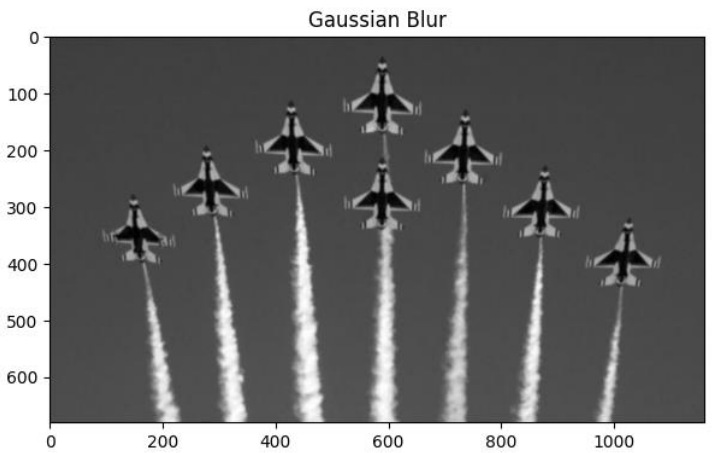

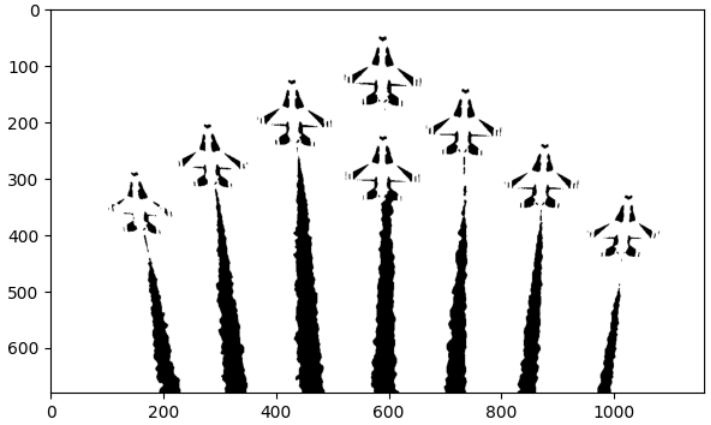

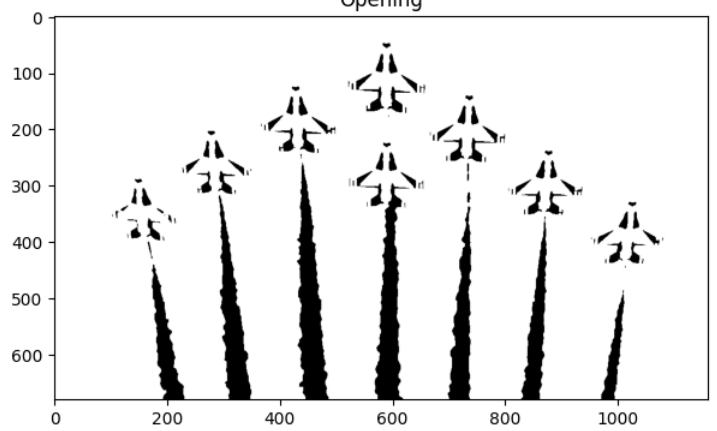

Object Detection Result

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IoU Threshold = 0.50

Metrik	Nilai	Penjelasan
True Positive (TP)	**8**	Jumlah deteksi benar yang sesuai dengan ground truth (IoU ≥ 0.5)
False Positive (FP)	**0**	Prediksi yang salah — mendeteksi objek yang tidak ada
False Negative (FN)	**0**	Objek asli yang tidak terdeteksi
Precision	**1.0000**	Semua deteksi adalah benar (tidak ada FP)
Recall	**1.0000**	Semua objek asli berhasil terdeteksi (tidak ada FN)
F1-Score	**1.0000**	Keseimbangan sempurna antara Precision dan Recall
Accuracy	**1.0000**	Semua hasil prediksi benar (tanpa kesalahan)
Mean IoU (matched)	**0.8805**	Rata-rata tingkat tumpang tindih antara kotak prediksi dan GT (88,05%)

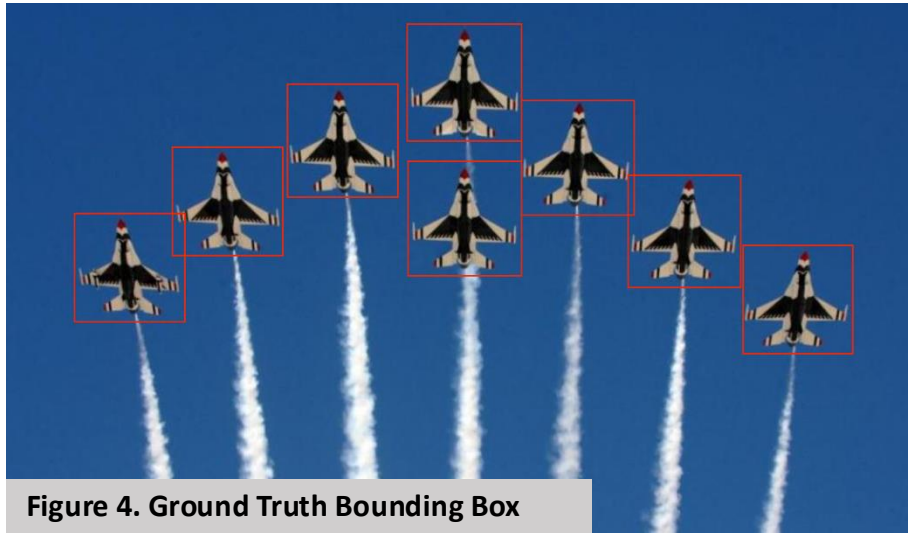

Figure 4. Ground Truth Bounding Box

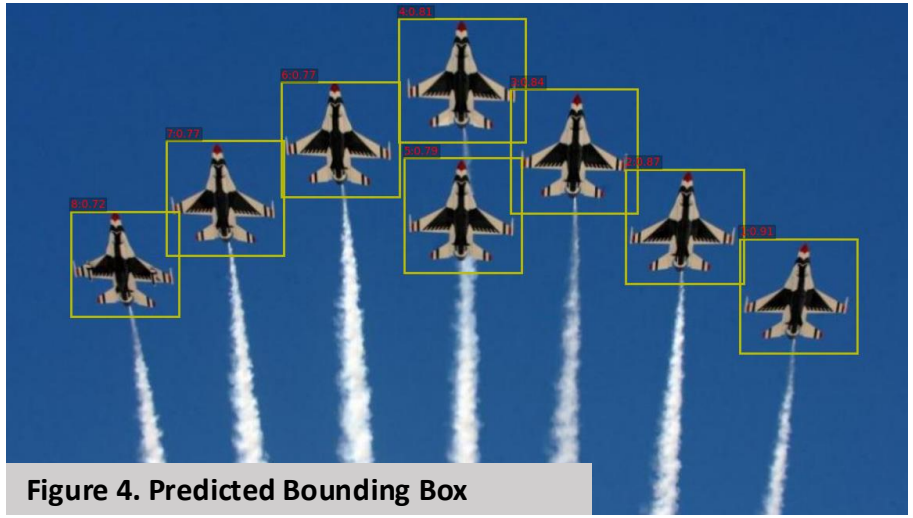

Figure 4. Predicted Bounding Box

Object Detection Result

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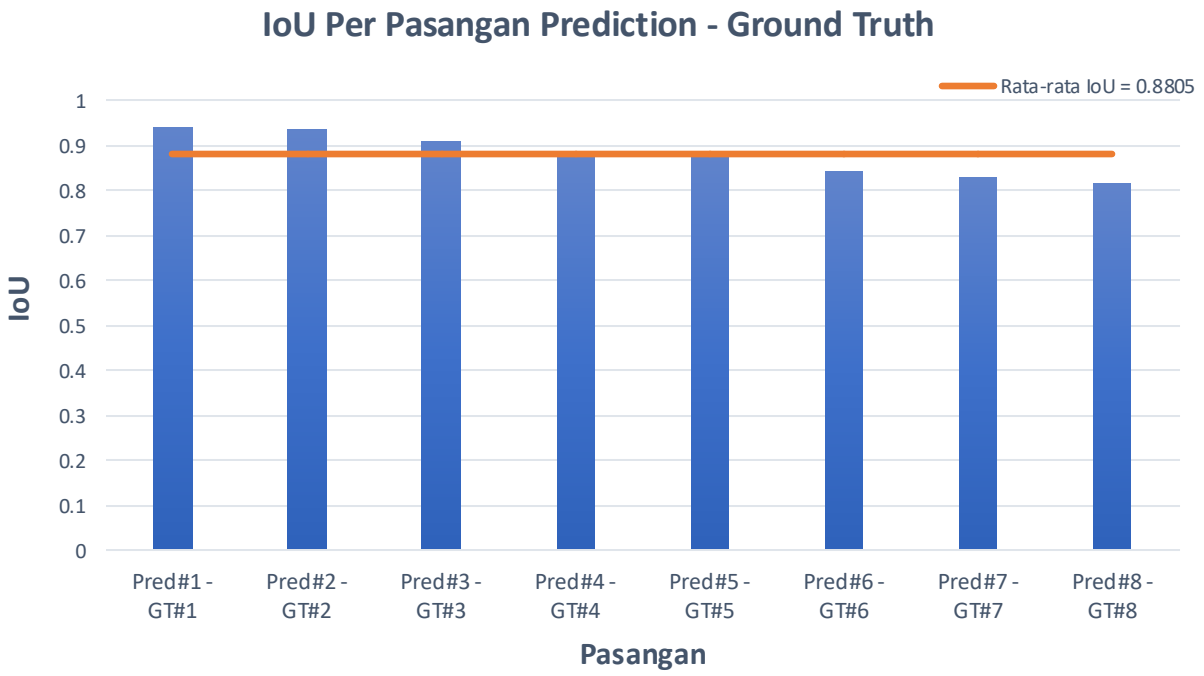
- Semua 8 objek berhasil terdeteksi dengan akurasi 100%.
- Tidak ada kesalahan deteksi (FP=0) maupun objek yang terlewat (FN=0).
- Rata-rata tumpang tindih antar kotak prediksi dan GT adalah **88,05%**.



No	Prediksi	Ground Truth	Nilai IoU
1	[x1=799, y1=223, x2=949, y2=369]	[x1=799, y1=222, x2=945, y2=365]	0.9408
2	[x1=91, y1=277, x2=229, y2=411]	[x1=89, y1=272, x2=230, y2=410]	0.9371
3	[x1=516, y1=209, x2=666, y2=355]	[x1=517, y1=205, x2=662, y2=350]	0.9101
4	[x1=213, y1=187, x2=363, y2=333]	[x1=215, y1=187, x2=355, y2=325]	0.8830
5	[x1=944, y1=312, x2=1094, y2=458]	[x1=949, y1=313, x2=1090, y2=450]	0.8828
6	[x1=360, y1=112, x2=510, y2=258]	[x1=364, y1=107, x2=504, y2=248]	0.8435
7	[x1=509, y1=31, x2=671, y2=189]	[x1=516, y1=29, x2=662, y2=178]	0.8300
8	[x1=652, y1=121, x2=814, y2=279]	[x1=663, y1=126, x2=807, y2=271]	0.8168

Prediksi = (x_min, y_min, x_max, y_max)
Ground Truth = (x_min, y_min, x_max, y_max)

Conclusion

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Kinerja Model (Segi Deteksi)

- Model deteksi sangat andal dalam menemukan semua jet, dengan *precision*, *recall*, dan *accuracy* sempurna (1.0).

Kinerja Model (Segi Lokalisasi)

- Mean IoU = 0,8805. Nilai ini menunjukkan rata-rata tumpang tindih antara kotak prediksi dan kotak GT pada pasangan yang terpasangkan adalah 88,05%. Dengan kata lain, selain semua objek berhasil ditemukan, tingkat ketepatan pelokalan (localization accuracy) juga tinggi.

Model tidak hanya menemukan semua objek (deteksi 100%), tetapi juga melokalisasi dengan akurat (mean IoU 0,8805), sehingga kinerja keseluruhan dapat dinilai sangat baik pada set dan ambang evaluasi yang digunakan.

URL GitHub

- Github : https://github.com/herlinalim-ugm/CVL_Assignment02.git

TERIMA KASIH

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