ETRI School

Multi-Task Learning for Recognizing Customer Characteristics

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Contents

Research Objective

Customer Characteristics Analysis

- My final goal is to build an integrated system for analyzing customer characteristics.
- This semester, I plan to implement each module. (Baseline construction and experimentation)

People Counting

Age/Gender/Expression ··· Recognition

System Utilization Examples

- Sales can be improved by providing a shopping experience that can increase satisfaction.
- Store can be managed efficiently.

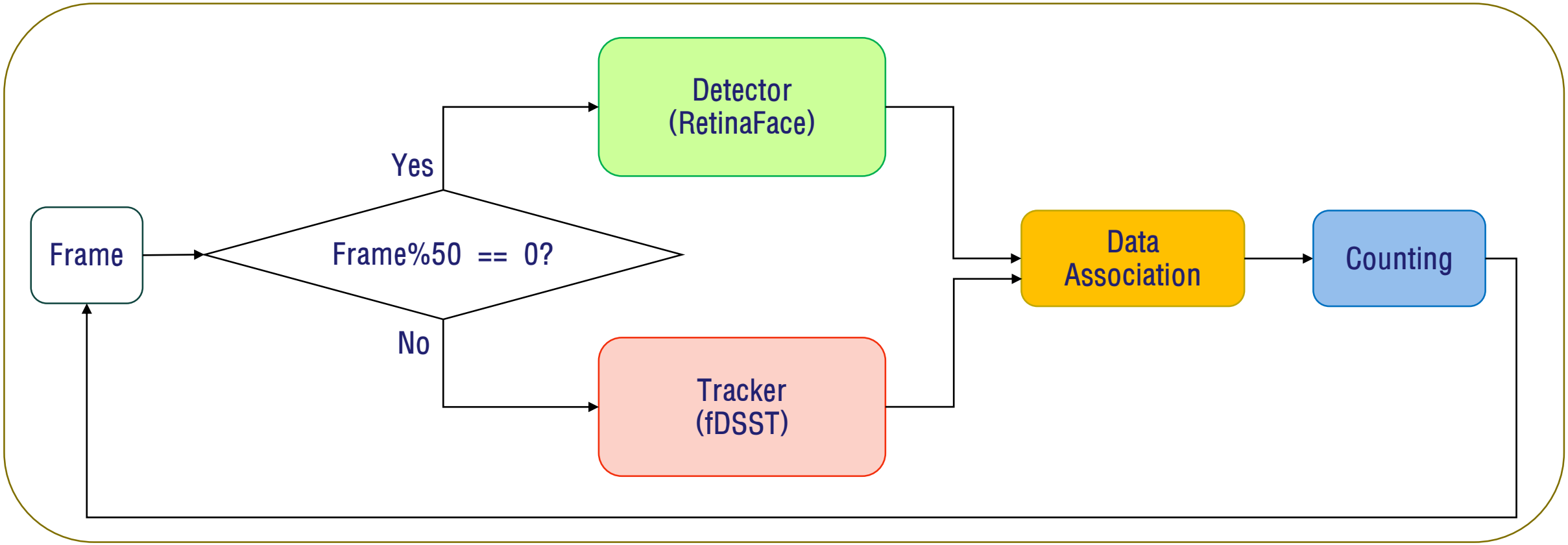
Section B (visited 3) & C (visited 15)
→ Move popular products to section C

20, Female, Section A,
→ Discount coupons for the most purchased products by women in their 20s

Method – People Counting

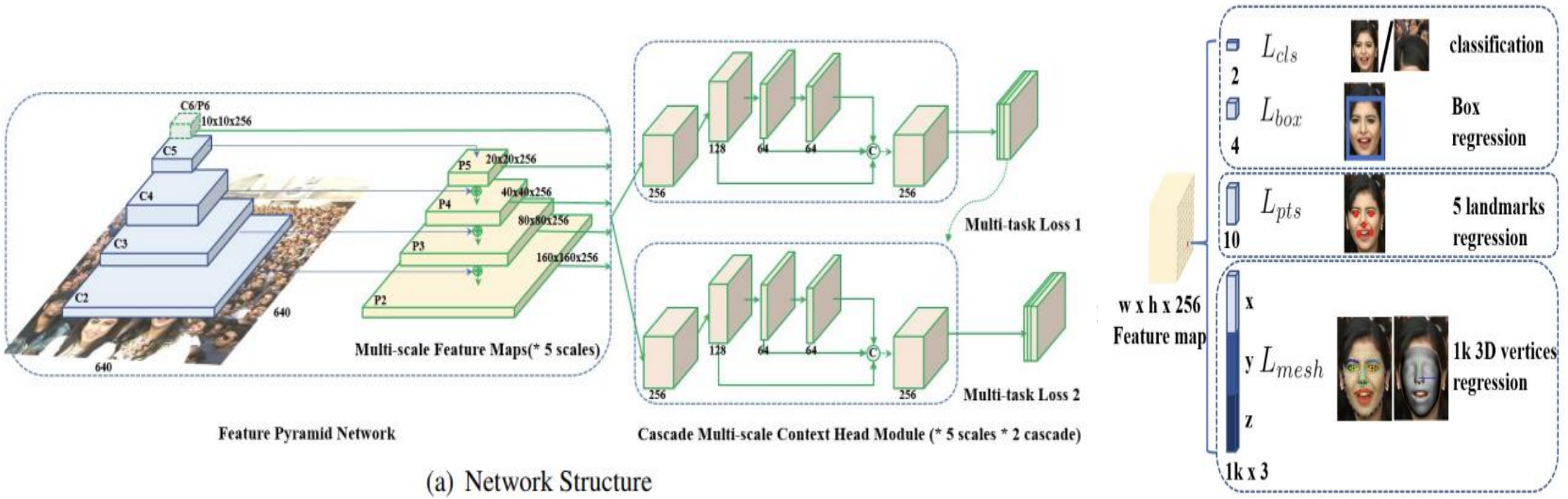
System Overview

- Detector is used to find specific objects in an image.
- Tracker is used for object tracking in a series of images.



Detector

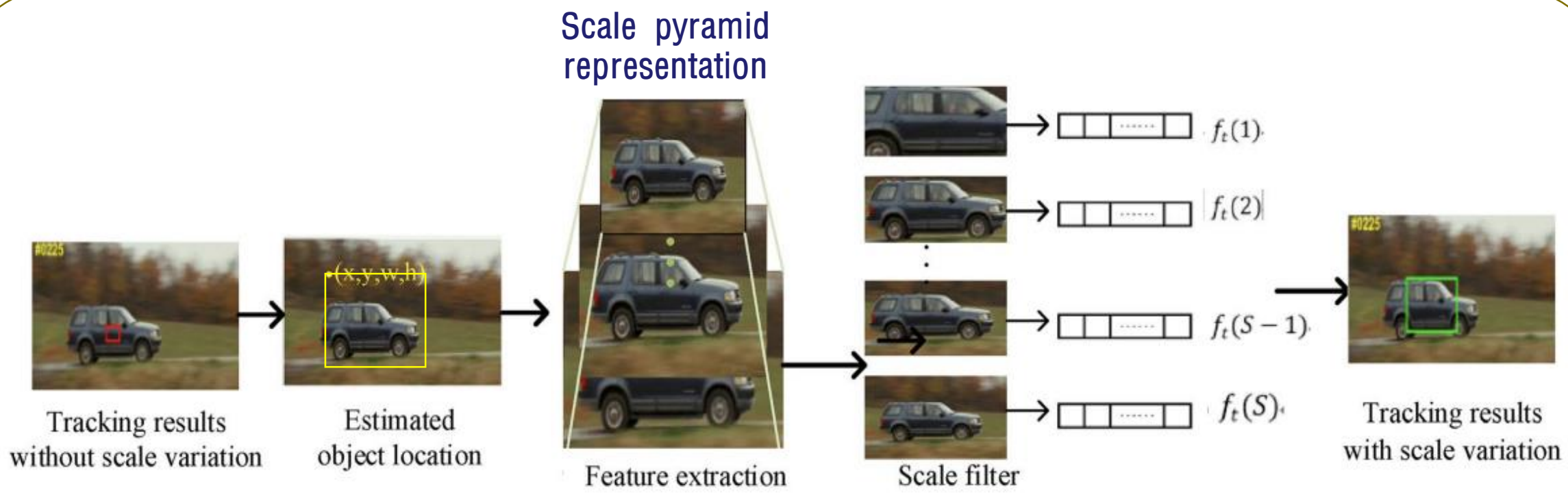
- RetinaFace is robust on pose estimation under expression variations, illumination changes and occlusions. (The model uses the real-world dataset, WIDER FACE)



J. Deng, J. Guo, E. Ververas, I. Kotsia, and S. Zafeiriou, "RetinaFace: Single-shot multi-level face localisation in the wild," *in Proc. IEEE/CVF Conf. Comput. Vis. Pattern Recognit. (CVPR)*, Seattle, WA, USA, pp. 5203-5212, Jun. 2020.

Tracker

- The Fast Discriminant Scale Space Tracker (=fDSST) is based on a correlation filter that handles scale changes in complex image sequences.



M. Danelljan, G. Häger, F. S. Khan, and M. Felsberg, "Accurate scale estimation for robust visual tracking," *in Proc. Brit. Mach. Vis. Conf. (BMVC)*, Nottingham, UK, pp. 1-11, Sept. 2014.

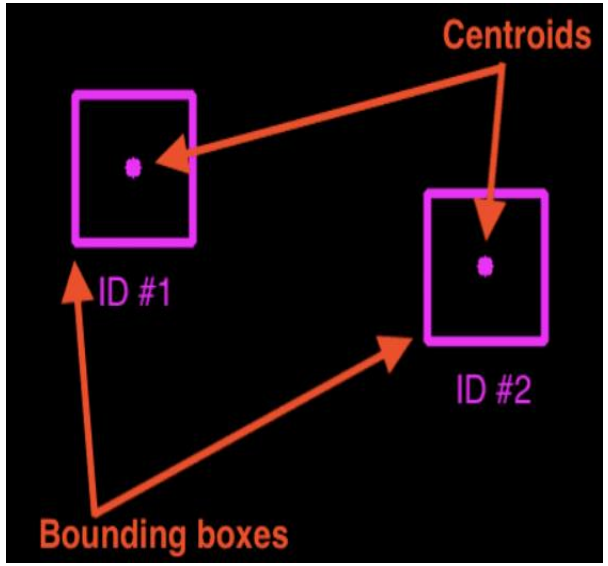
Data Association (1/2)

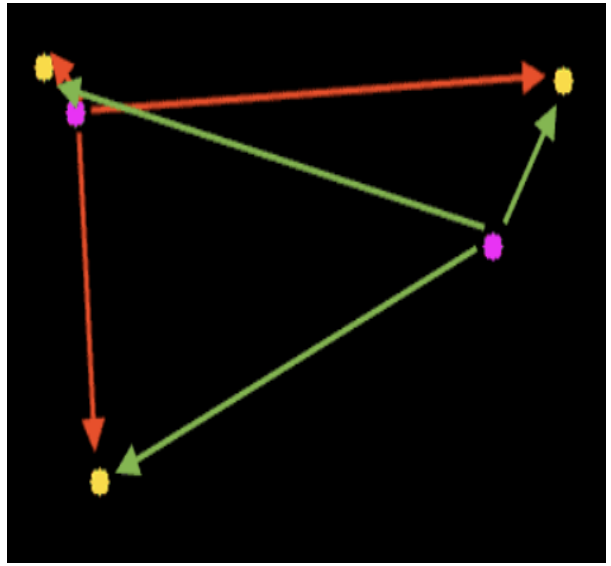
- Centroid algorithm
  - The center of bounding box

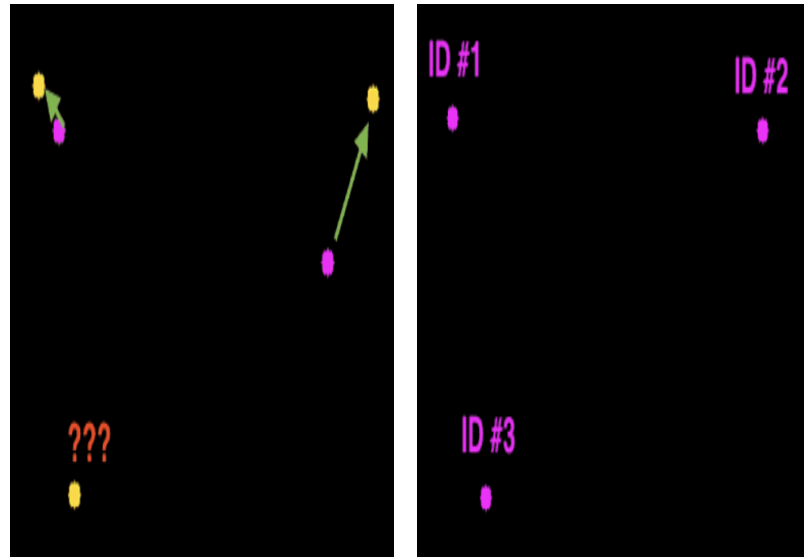
① Find bounding boxes and centroids

② Calculate euclidean distance
- Yellow: Frame(T) centroid
- Purple: Frame(T-1) centroid

③ Update (X,Y) position
④ Register new object





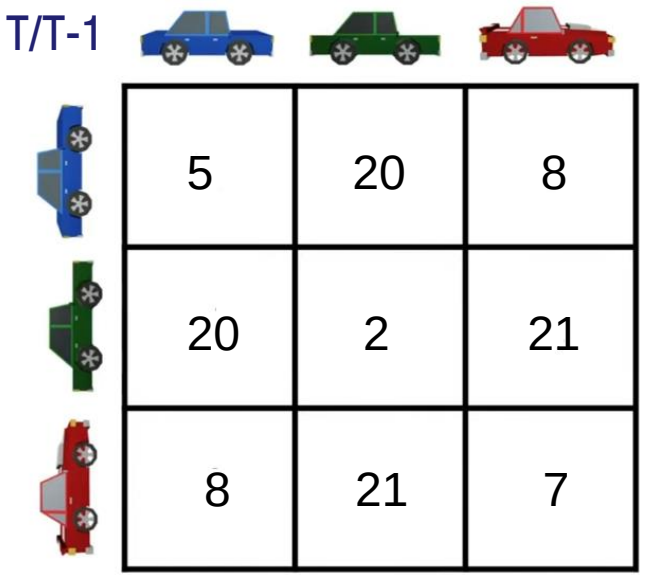


- J. C. Nascimento, A. J. Abrantes, and J. S. Marques, “An algorithm for centroid-based tracking of moving objects,” *in Proc. ICASSP99*, Phoenix, AZ, USA, pp. 3305-3308, Mar. 1999.

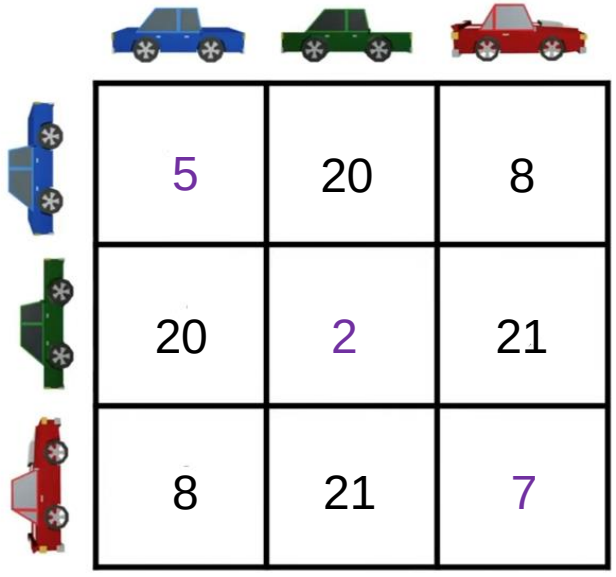
Data Association (2/2)

- ID Matching
  - T: Now frame objects, T-1: Previous frame objects

① Generate the cost matrix(=C)



② Find the minimum value index
Row: [1, 0, 2], Column: [1, 0, 2]

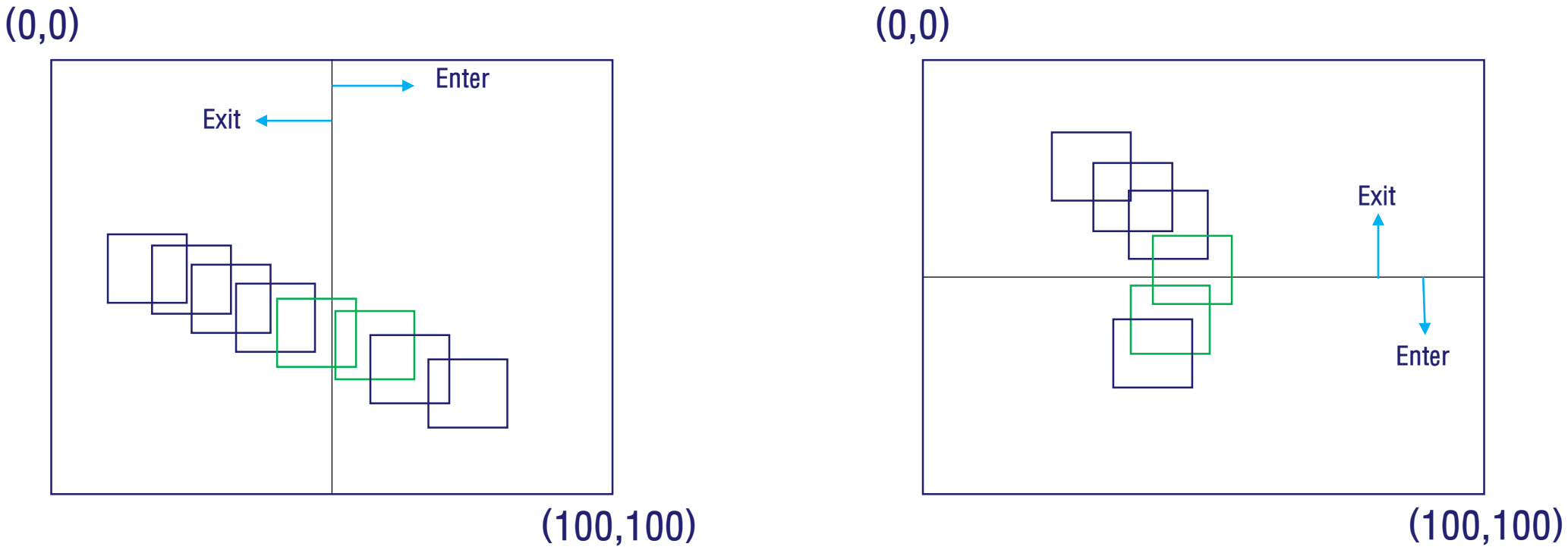


③ ID assignment

(Max_distance = 10)
C[1,1] < 10? Yes, ID 1
C[0,0] < 10? Yes, ID 0
C[2,2] < 10? Yes, ID 2

Counting

- After crossing the line, the count increases.
  - Vertical line: using X coordinate, Horizontal line: using Y coordinate

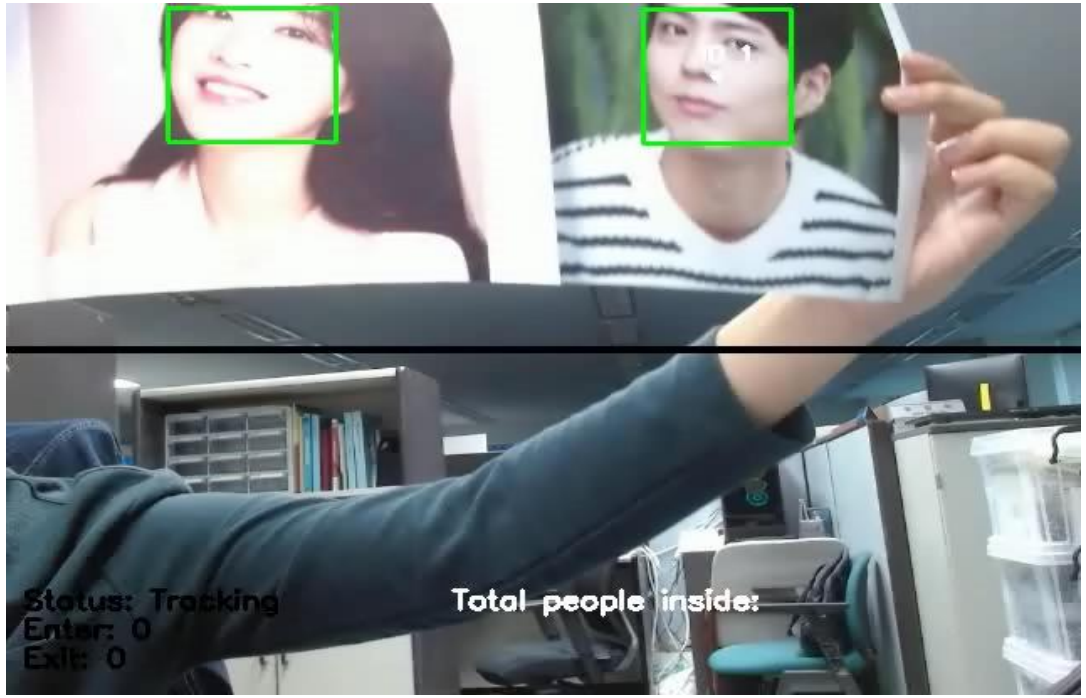


Experiment & Result

Demonstration

- Real-time test results using pictures.
  - It is necessary to consider distinguishing between photographs and human faces.

Enter ↓



Exit ↑

Experiments on Multiple Faces Dataset

- Experiments were conducted using public datasets.
- Missing ID and overlapping problem.

Method	DB (SPEVI)	Resolution (resize)	Total frames	Counting results (GT)
RetinaFace + fDSST	Montinas_fast	500×500	487	5 (3)
	Montinas_frontal	500×500	1276	27 (4)
	Montinas_turning	500×500	1006	20 (4)

Limitations (1/2)

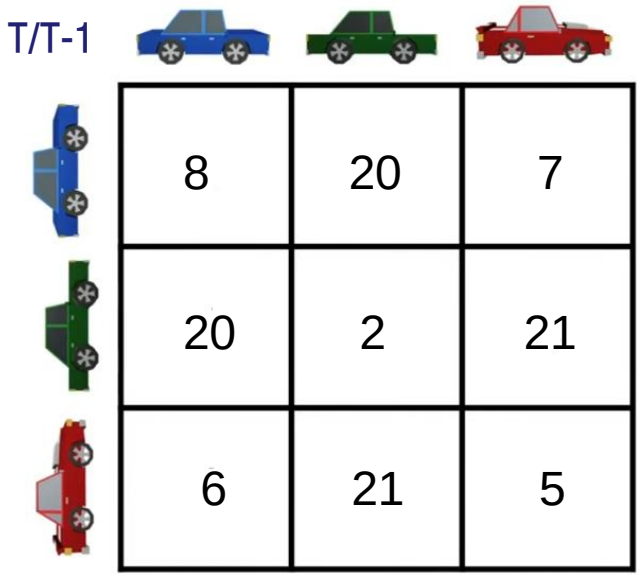
- Example of missing and duplicating.
- Red box: detection result, Green box: tracking result

Frame 0 Frame 1 Frame 20 Frame 21 … Frame 49 Frame 50

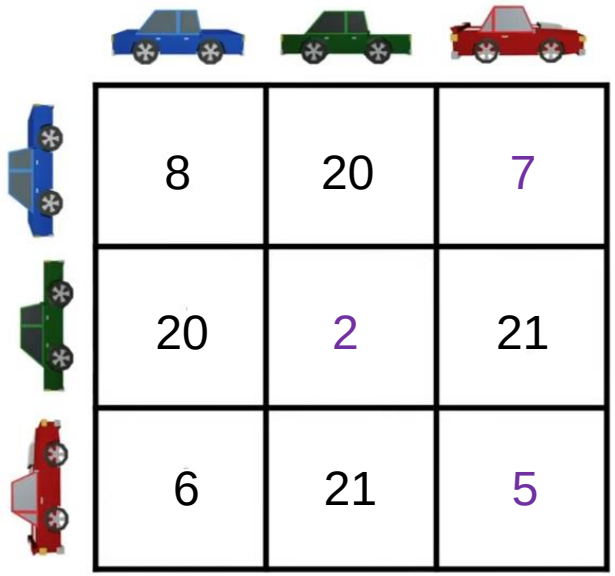
Limitations (2/2)

- ID Matching (Occlusion)
  - T: Now frame objects, T-1: Previous frame objects

① Generate the cost matrix(=C)



② Find the minimum value index
Row: [1, 2, 0], Column: [1, 2, 2]

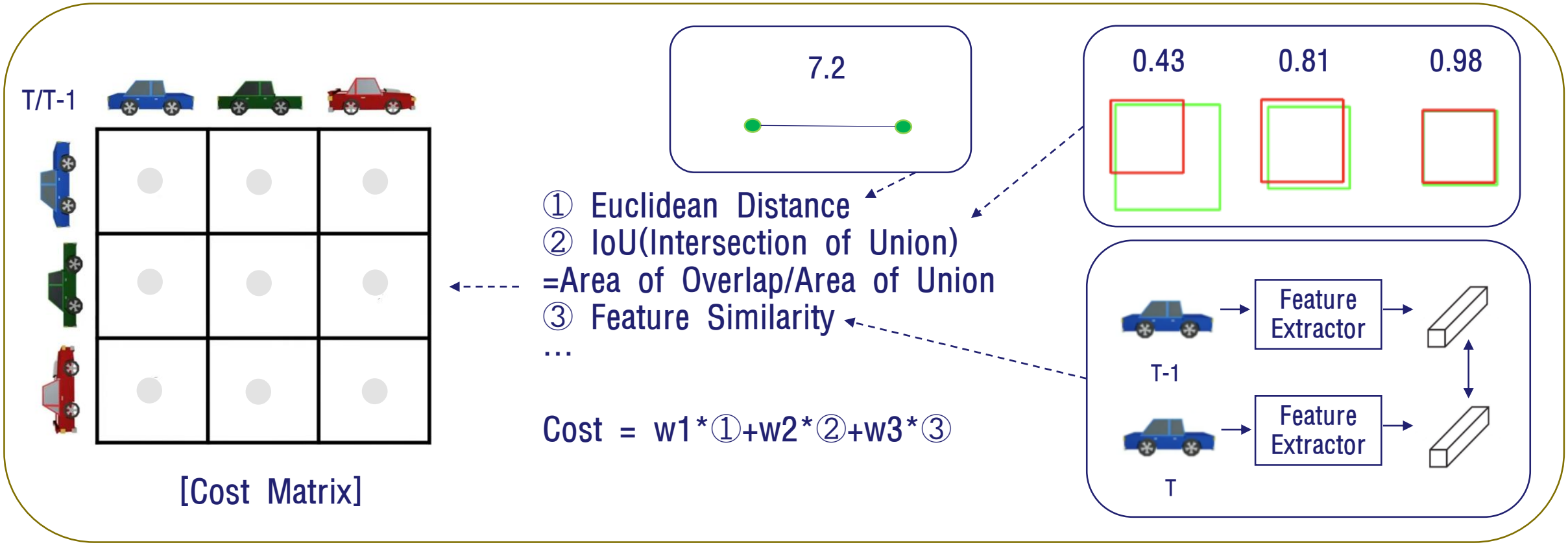


③ ID assignment

(Max_distance = 10)
C[1,1] < 10? Yes, ID 1
C[2,2] < 10? Yes, ID 2
C[0,2] < 10? Yes, ID 2
→ Blue car ID 2 (Duplicated)

Improvement Method

- The previous method calculates the cost only by the distance between the two centroids.
  - Using diverse values for calculating costs.



Conclusion

Summary & Future Works

[Summary]
- My goal is to create an all-in-one system for analyzing customer characteristics.
- This semester, I plan to implement each module.
  1. People Counting Module (V)
  2. Age/Gender/Expression … Recognition Module

[Future Works]
- Implement MTL module

Reference

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- 작가 macrovector 출처 Freepik

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- J. Deng, J. Guo, E. Ververas, I. Kotsia, and S. Zafeiriou, "RetinaFace: Single-shot multi-level face localisation in the wild," *in Proc. IEEE/CVF Conf. Comput. Vis. Pattern Recognit. (CVPR)*, Seattle, WA, USA, pp. 5203-5212, Jun. 2020.

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Q & A

Thank you