Deep Neural Network class

Final term project :

Automatic License Plate Recognition

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Object

- Detect and recognize Korean license plate from images with high accuracy and high speed

- Evaluation
  - ✓ Accuracy
  - ✓ Processing time

$$Score = Score_{park} + Score_{cctv} + 0.1 \times (100 - PT)$$

$$PT = m\sec./image(average)$$

$$Score_i = Accuracy_{det} + Accuracy_{rec} \quad (i = park\ or\ cctv)$$

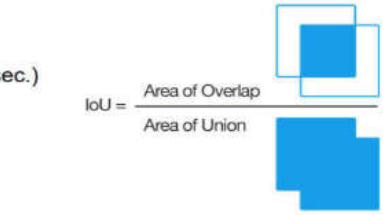
$$Accuracy_{det} = \frac{1}{n}\sum_{i=0}^{n-1} \frac{\#TP_{det} - \#FP_{det}}{\#GT} \times 100\%$$

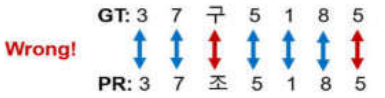
$$Accuracy_{rec} = \frac{1}{n}\sum_{i=0}^{n-1} \frac{\#TP_{rec}}{\#GT} \times 100\%$$

- PT: average processing time of the model (unit: msec.)
- $\#TP_{det}$: number of true positive for detection
- $\#FP_{det}$: number o false positive for detection
- $\#TP_{rec}$: number of true positive for recognition
- #GT: number of ground-truth

- TP_{det}: IoU >= θ, θ=0.7
- FP_{det}: IoU < θ

IoU = Area of Overlap / Area of Union

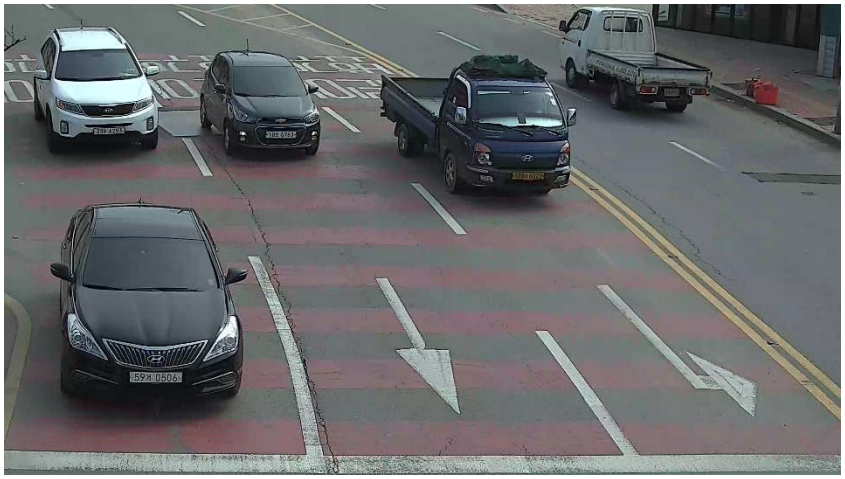


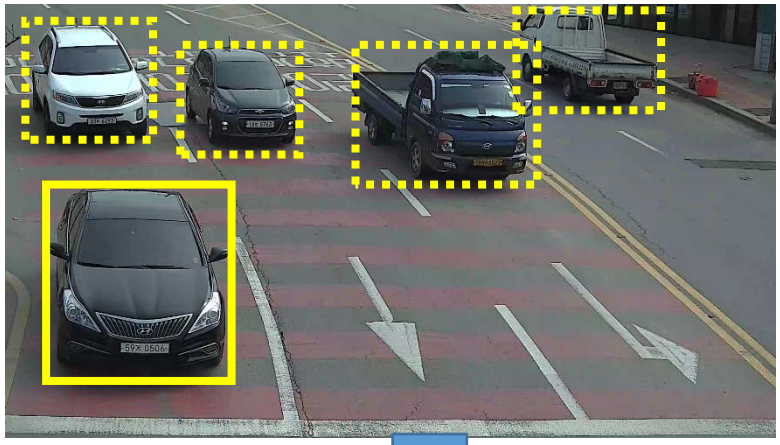


Dataset

- 1. Parking Dataset
- Total : ## images
- Format : .jpg +.txt
- Gray color
- Have only one car
- Fixed car position
- Simple background
- Relatively good resolution

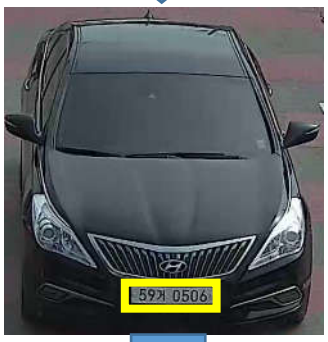
- 2. CCTV Dataset
- Total : ## images
- Format : .png +.xml
- RGB color
- Have more than one car
- Different car position
- Poor resolution





Step1
: Vehicle detection
: YOLOv3

Crop vehicle image



Step2
: LP detection
: YOLOv3

Crop LP image

Step3
: LP Character recognition
: Tesseract-OCR

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Step 1: Vehicle detection

- YOLO (You Only Look Once)

✓ A state-of-the-art, real-time object detection system

✓ YOLOv3 : Consists of 106 layers

✓ Strong points : extremely fast

✓ Weak points : poor accuracy for small object

✓ Solution

=> detect vehicle first and crop vehicle image

=> Detect license plate from cropped vehicle image

✓ Fine turning

=>Detect 80 classes -> 3 classes (car, bus, truck)

Step 2. License plate detection

- YOLO (You Only Look Once)
  - ✓ YOLOv3 : Consists of 106 layers
  - ✓ Detect 6 Types of license plate

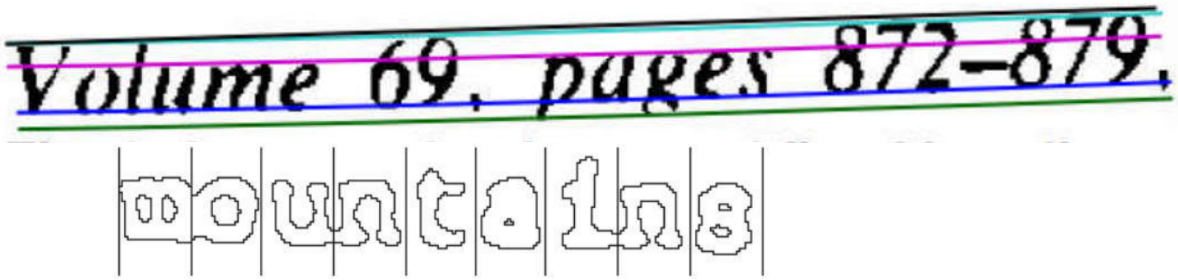
Type	License Plate		Type
1			P1
2			P2
3		서울52바3108	P3
4		서울52바3108	P4
5		43가6510	P5
6		부산27무6662	P6

Recognizing plate type is not our task

Step 3. License plate recognition

- **Preprocessing**
  - ✓ RGB to Gray
  - ✓ Enhancement
  - ✓ Crop boundaries
  - ✓ Enlargement
  - ✓ Binarization

- **Tesseract-OCR**
  - ✓ Use 4.0.0 ver based on LSTM



Conclusion

- Low accuracy
  ->didn't develop Model for parking and CCTV data separately
  -> didn't retrain Tesseract-OCR font for license plate

- Slow processing time
  -> need too much time for saving each processed image

Thanks you!