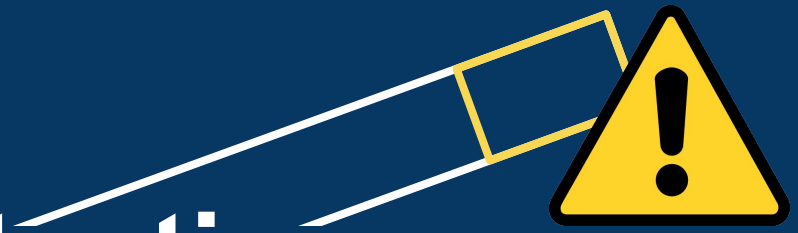
Ambient AI Boot Camp Project



Smoking Detection

using Google Coral

Team : TripleA

Jihoon Han, Minwoo Park, Chae-eun Lee

Contents

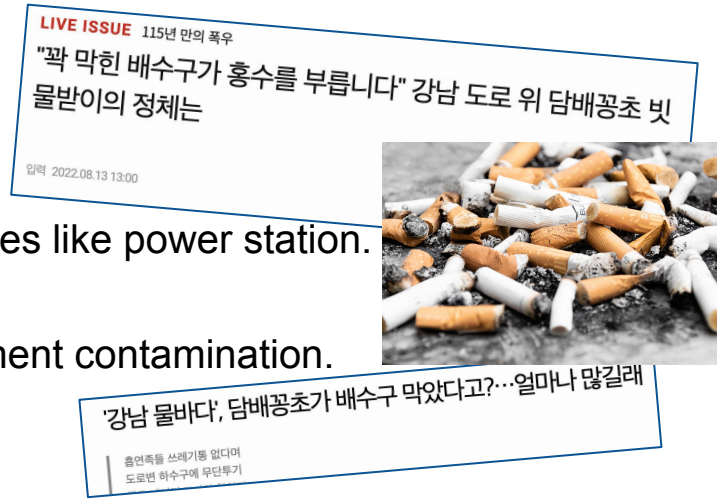
1. Motivation

Motivation

- **Problem**

① Safety Problem
In particular case, it can lead to serious accidents.
More dangerous especially nearby fire-sensitive places like power station.

② Environment Problem
Cigarette wastes thrown everywhere cause environment contamination.



- **Causation**

① Lack of smoking area
287,200 non-smoking area / **7,089** smoking area in Seoul

② Lack of public awareness
People smoke cigarettes everywhere without moral conscience

출처 : MKNEWS, 한국일보
https://www.mk.co.kr/news/society/view/2022/08/706192/
https://m.hankookilbo.com/News/Read/A2022081215070000668
https://news.mt.co.kr/mtview.php?no=2021051113425236128

Life cycle of smoking detection model

Smoker image data

1) More smoking areas made

1) Capable to receive Smoker data

1) Detect smoking by utilizing smoker data

1) Less smoke waste

Provides more smoking area in order to obtain various smoker data

2. System Overview

System Overview

- **Why Vision?**
  As micro hardware technologies has been developed, we are able to receive high quality images with smaller cameras. -> We want to use this benefit!
- **Why Object Detection?**
  Can detect specific movement/object fast and prevent before smoking starts.
- **What is better than smoke detector?**
  Faster prevention before smoking. Can detect specific smoker features.
- **Why Edge Device?**
  Can be used widely in various places with less social/technical entry barrier. (e.g. privacy policy, server capacity, etc.)

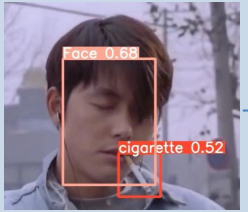
Application Scenario in detail

- PHASE 1: Detect smoking pose → Crop → Input for phase 2 Object Detection
- PHASE 2: Detect face and cigarette → Measure distance → Alert

Detect Smoking pose

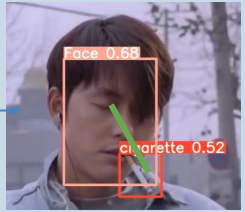
new input

Image crop

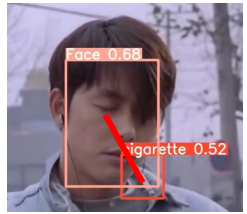


Detect face and cigarette

new input



Measure distance of face and cigarette

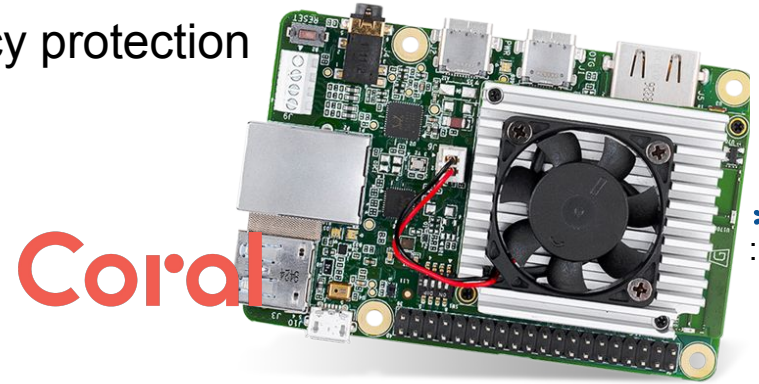


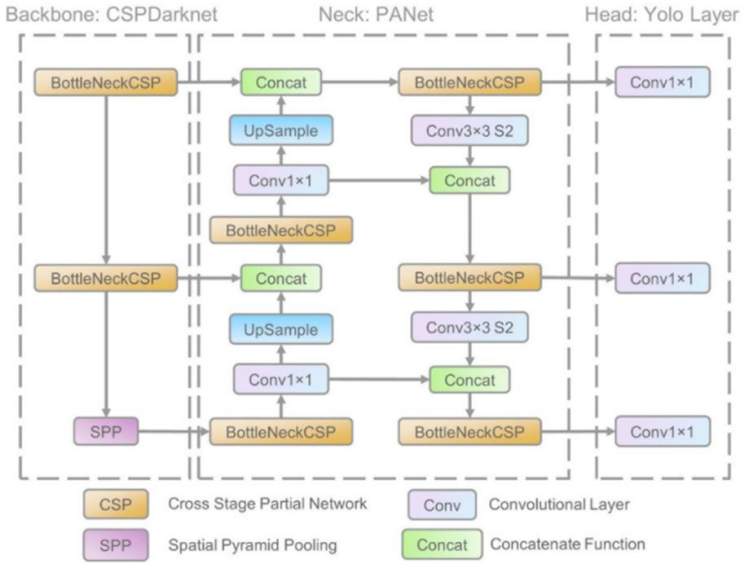
Alert when get closer

test video source : https://www.youtube.com/watch?v=88FVg40OP5I

System Overview

- **Why yolov5?**
  - Great performance at object detection
  - Detailed source code exists
- **Why Coral?**
  - Collected data used locally
  - Privacy protection





*** YOLOv5(You Only Look Once)**
: Object Classification + Location Detection in one stage

3. Data Preparation

Data Preparation

Collect various size, angle, type of images to raise performance

	Cigarette	Face	Total
Train	8,983	8,553	**17,536**
Validation	1,020	1,843	**2,863**
Total	**10,003**	**10,396**	**20,399**

4. Challenges

Challenges 1 - Masking

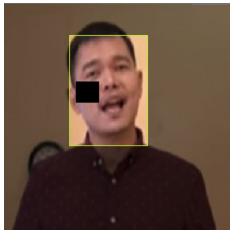
- **Problem**

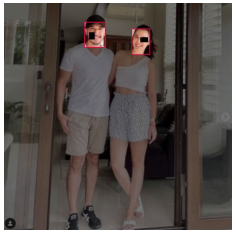
Cannot detect face when part of it is hidden.

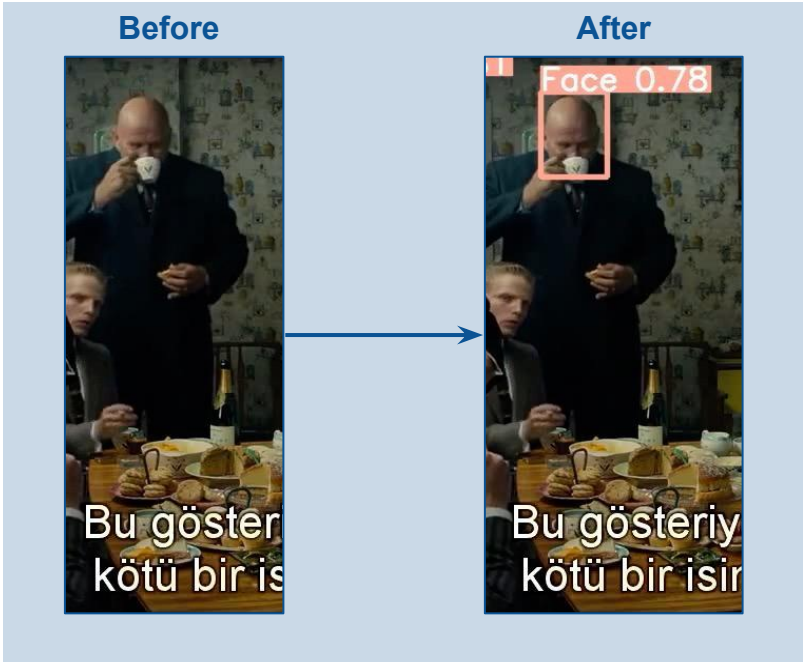
- **Solution**

Added face datasets which include masking.

Examples.







test video source: https://www.youtube.com/watch?v=00qVqaEat3s

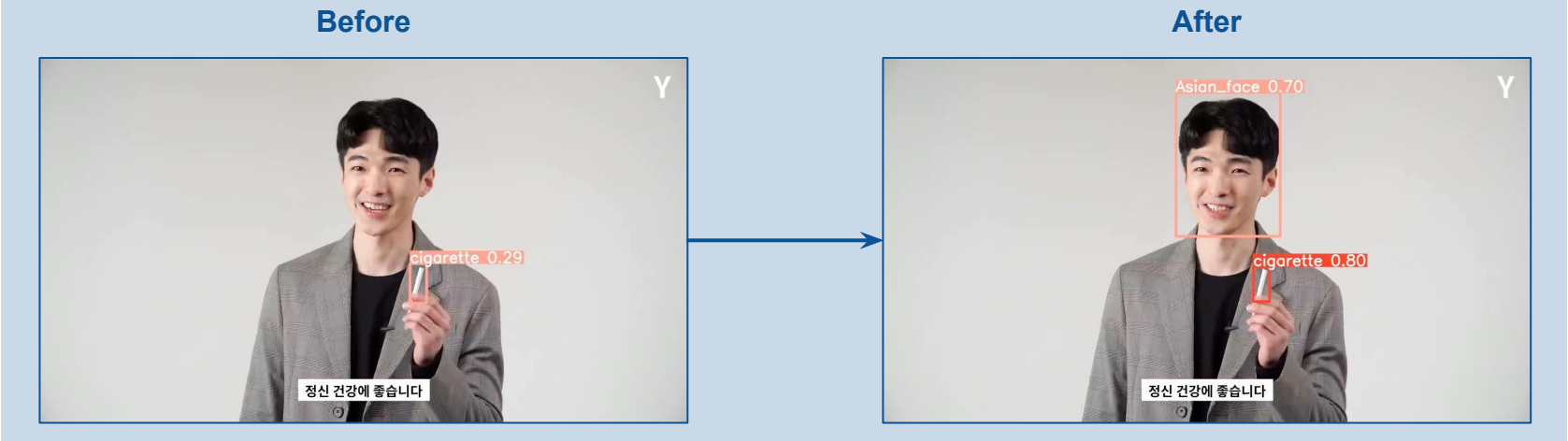
Challenges 2 - Race

- **Problem**

Could not detect all races accurately. Especially asian faces were not detected.

- **Solution**

Collected dataset of asian faces and trained our model.



test video source: https://youtu.be/WoOGi3M7BNc

Challenges 3 - Various angle of Faces

- **Problem**

Failed to detect various angled faces occasionally.

- **Solution**

Collected more side face datasets.

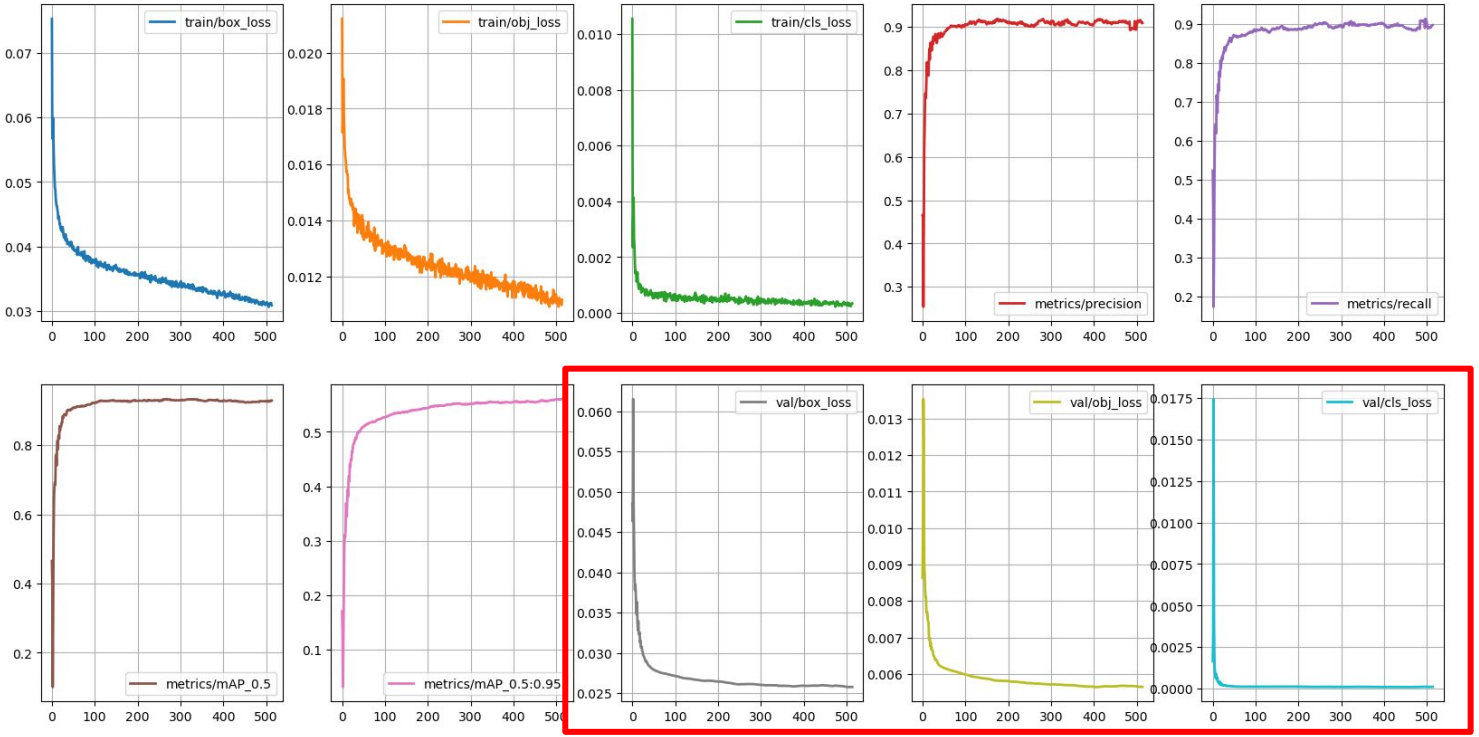
Challenges 4 - else

Other Problems

- Could not use gpu cluster until 4 days before the due date.
- Difficulty in collecting various types of face and cigarette data.
- Converting pytorch yolov5s model to edgetpu.tflite file was a huge challenge.

5. Results

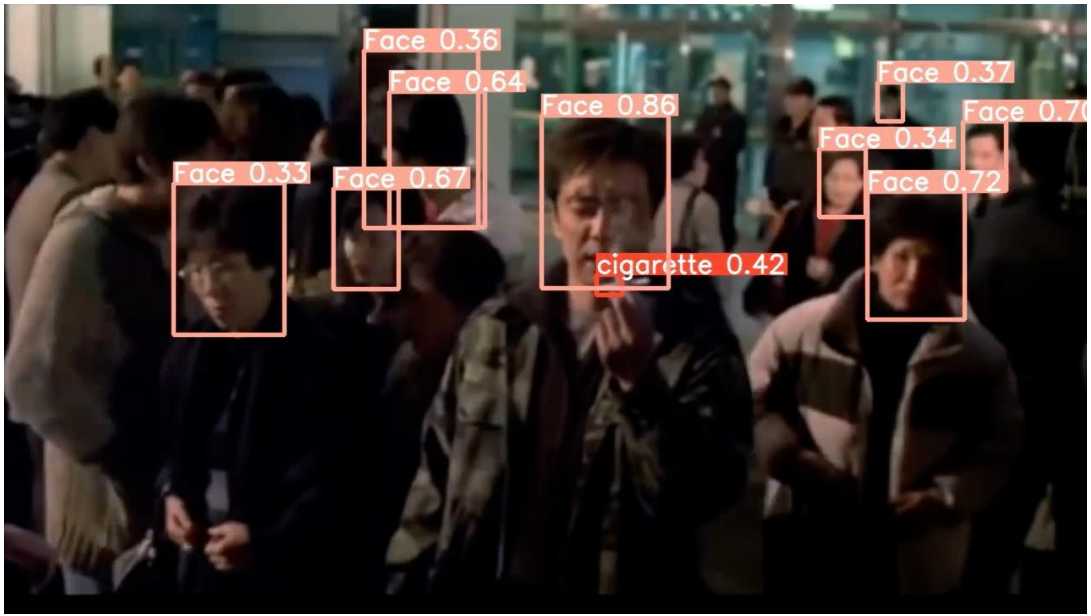
Results



* Dataset(train:valid) = 20,399 [cigarette(8,983:1,020), face(8,553:1,843)]
* Hyperparameter = epoch : 515, batch : 48, img size : 640

Results - Example

iou = 0.7, conf = 0.3



face, cigarette

Demo

6. Conclusion

Future Works

- Measure distance between face and cigarette.
- Alert smokers.
- Connect two-stage models as one to put in Google Coral
  (Smoking-pose detection model, face - cigarette distance model)
- Detection of other objects related to cigarette (e.g. lighters, cigarette pack, smoke, etc.)

Conclusion

- Hard to distinguish between cigarette and seems-like cigarette object.
- Unstable detection. Needs more data and computing.
- Learned importance of dataset quality and balance.

Thank you