HUST

ĐẠI HỌC BÁCH KHOA HÀ NỘI

HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

ONE LOVE. ONE FUTURE.

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Mini project report

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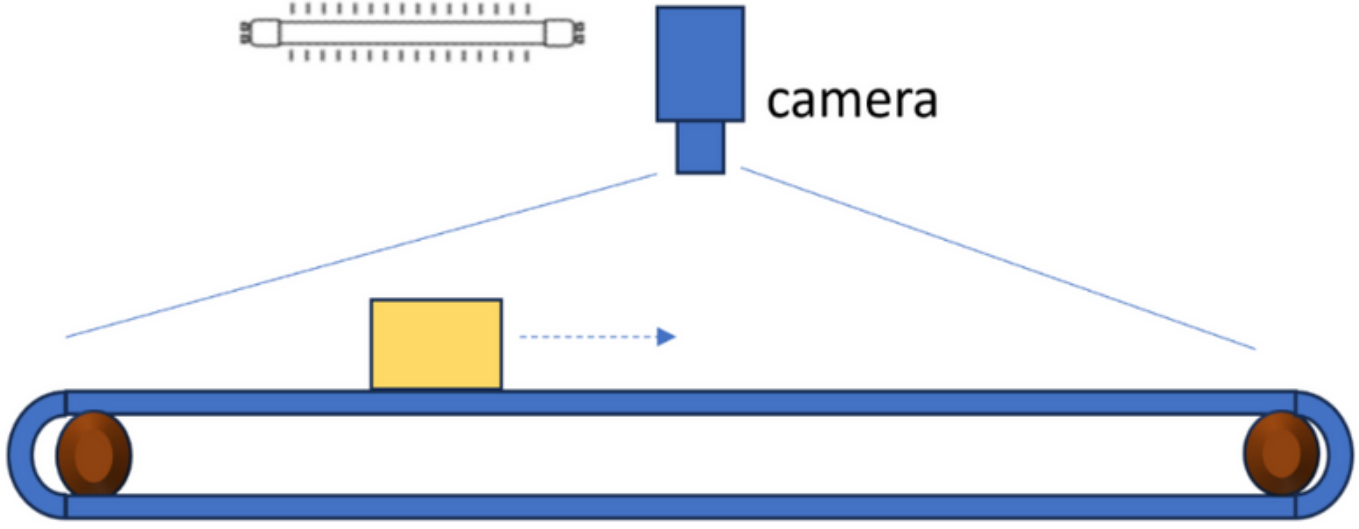
OUTLINE

1. Problem
2. Method
3. Details
4. Test and evaluate
5. Conclusion
6. Improvement

1. Problem

Problem statement :

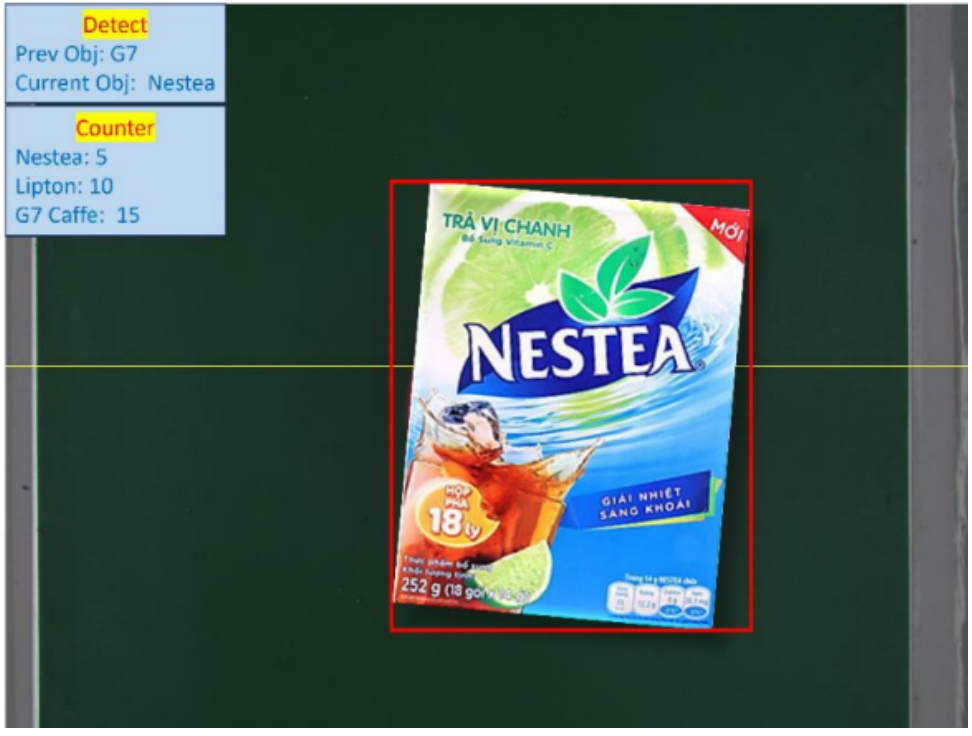
- Conveyor transport products
- Fixed cameras and light source
- Type of product : confectionery



1. Problem

Target :

1. Classify the goods
2. Count the number of each class
3. Show results



1. Problem

Challenges :

- Item size diversity
- Noise in background
- Limited resource
- Processing time

1. Problem

Good points :

- Item straight orbit
- Low moving speed
- Light conditions
- Single object per frame
- Fixed background

2. Method

How to select model ?

Survey of recent research on the **performance** and **inference speed** of object detection models

Model	Recall (%)	mAP (%)
CenterNet	58.0	81.2
YOLOv4	74.0	76.2
YOLOv5	79.4	84.1

[1]

Method	Params (MB)	inference time (ms)
Yolov5	89.0	6.6
CenterNet	74.99	28

[2]

Pipeline inference

Resize
CvtColor

Check object pass the marked zone

Image processing

Prediction

Bounding boxes infor

Fine-tuned Yolov5n

Create counter

Show image ouput

Post processing

DATA PROCESSING

- After being resized, check whether the object has passed the marked area

Gray scale

Binary

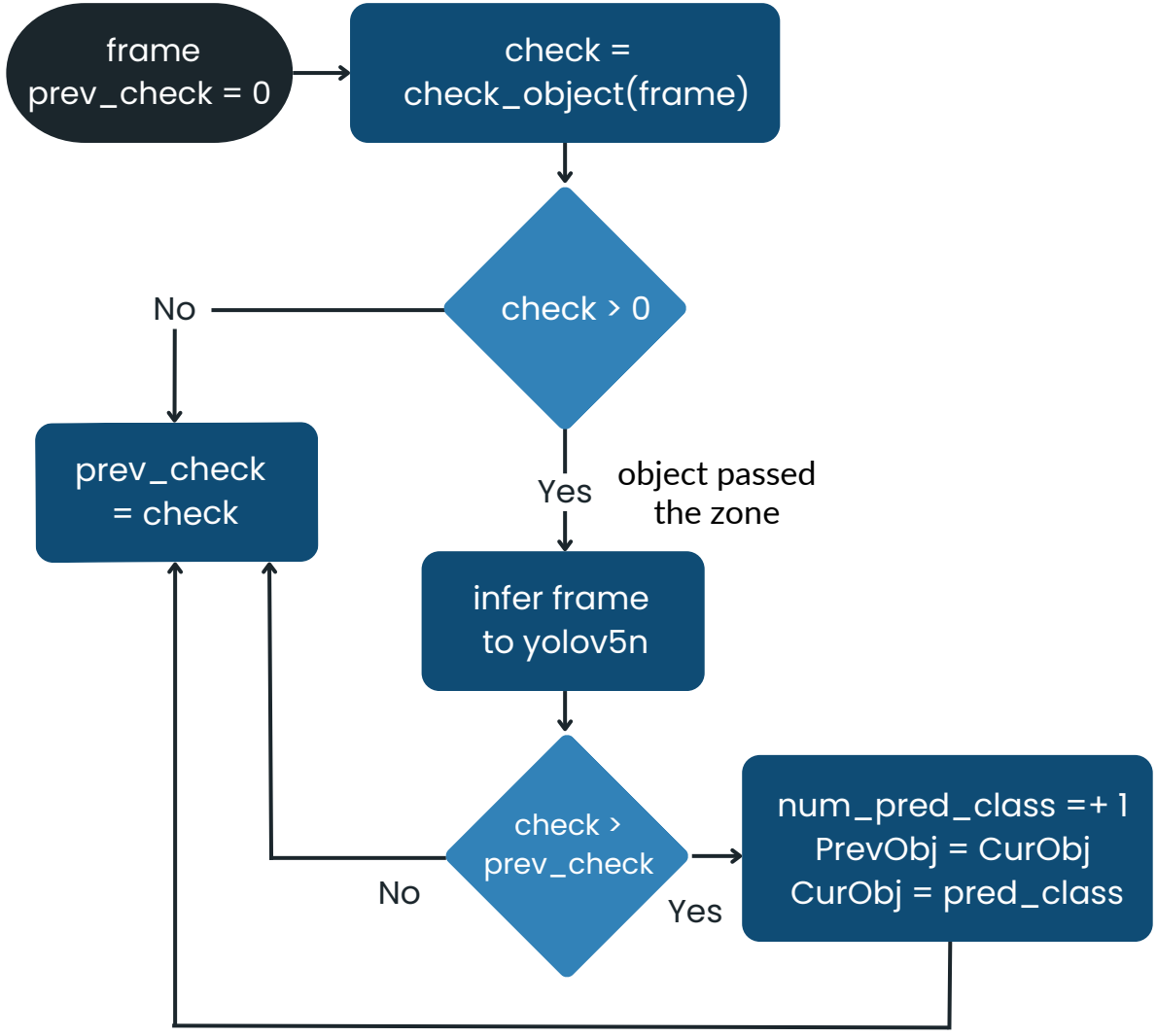
Median Blur

3. Details

COUNTER

```
table_data = [
    ["orion", 0],
    ["tipo", 0],
    ["y40", 0],
    ["nestea_hoaqua", 0],
    ["chanh", 0],
    ["nestea_atiso", 0],
    ["karo", 0],
    ["jack-jill", 0],
    ["g7", 0],
    ["dilmah", 0]
]
```

```
detection = [
    ["Prev", ""],
    ["Current", ""],
]
```



3. Details

Training

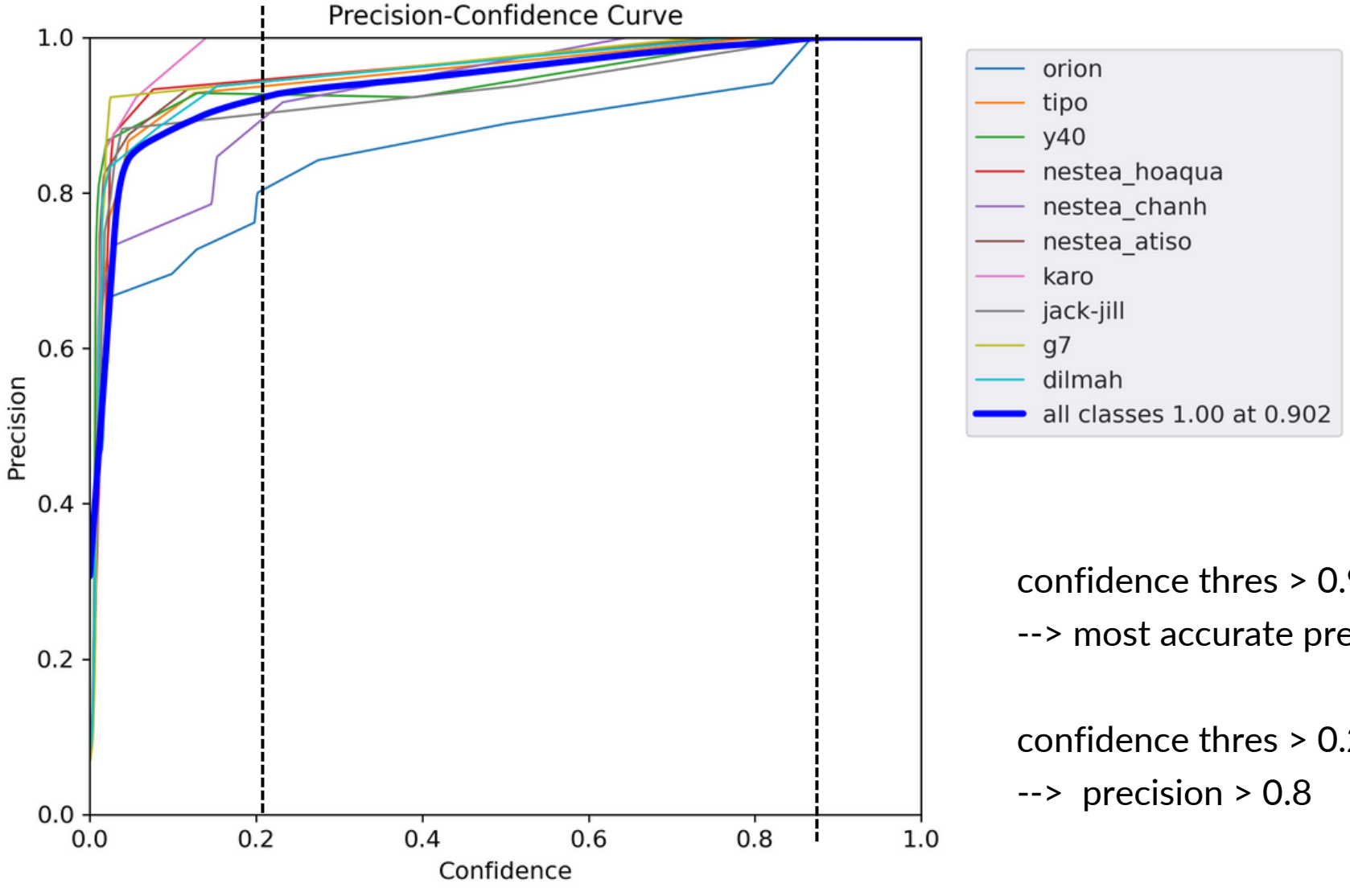
Data :

- cellphone_video_for_train (all to train data)
- conveyor_video_for_train (similar to test video)
- train/val/test = 1177 / 151 / 138
- classes ratio range from 7 - 11%

Labels :

- using tool LabelImg then trained YOLOv5 for auto labelling

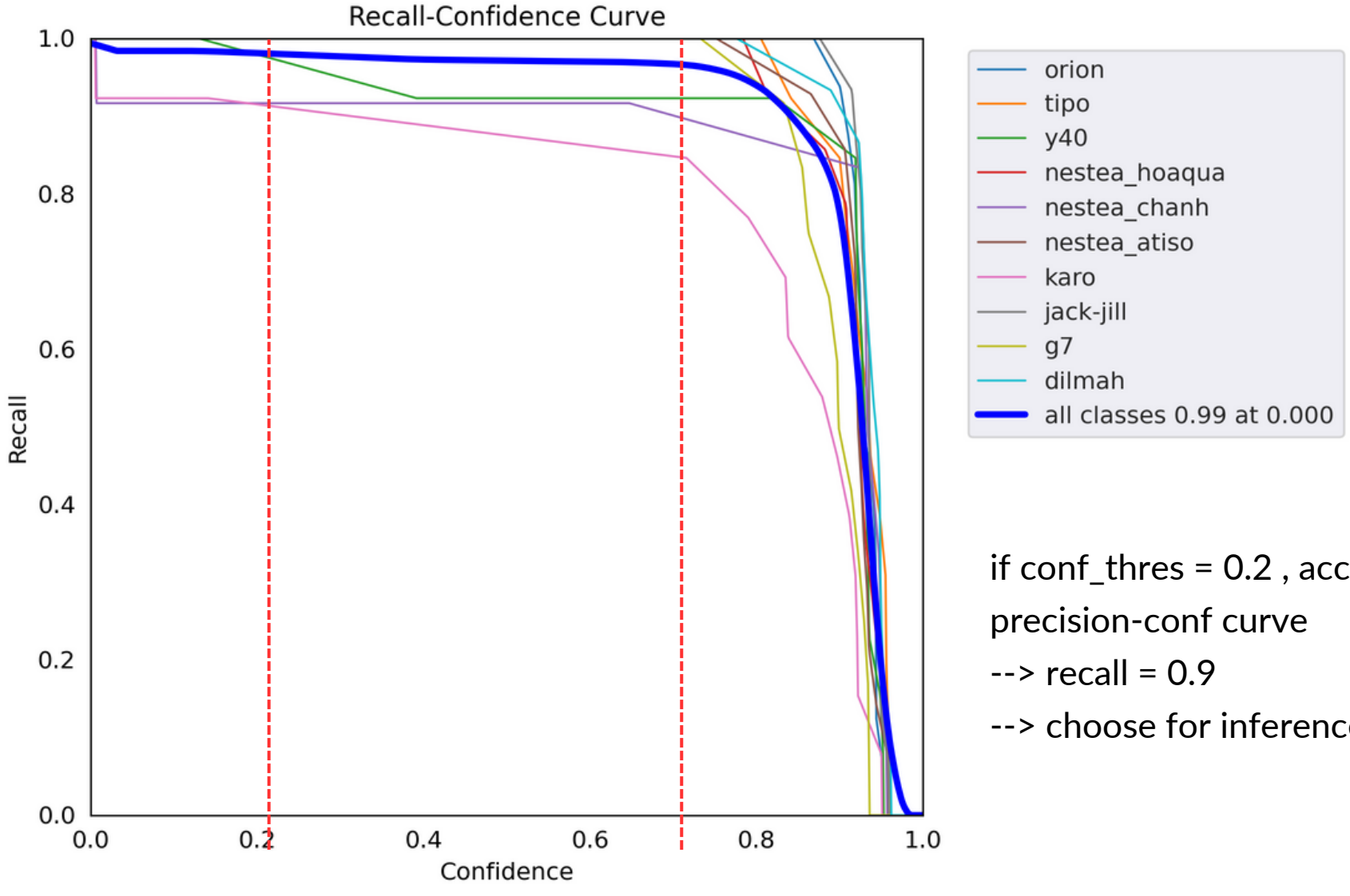
4. Test and Evaluate



confidence thres > 0.902
--> most accurate prediction

confidence thres > 0.2
--> precision > 0.8

4. Test and Evaluate



if conf_thres = 0.2 , according to precision-conf curve

--> recall = 0.9

--> choose for inference thres

4. Test and Evaluate

Inference

Video inference : 3m14s length and 16 fps

Hardware :

- CPU 11th Gen Intel(R) Core(TM) i7-11800H @ 2.30GHz
- 8 cores, 12GB RAM

Inference time

- frame no object : 4-6 ms
- frame with object : 35-50ms
- whole video : 80 seconds

4. Test and Evaluate

Inference

Output screenshot

5.Conclusion

- With small training data, the counter return results accurately but the bounding boxes do not overfit
- **Satisfy** the 3 requirements of project output
- **Limitation:** when having new item, must label manually again and then train the yolov5 again

6.Improvement

Improve proposed method :

Only infer the frame that object just passed the marked zone, then save that frame to .png at local to check results

--> only have to infer 11 frames

--> inference time :

- frame no object : ~1 ms
- frame object : 70-80 ms
- video inference time : 20s

6.Improvement

New approach :

- Image processing to detect boxes, the crop
- Process data to create training dataset
- Train simple CNN to classify

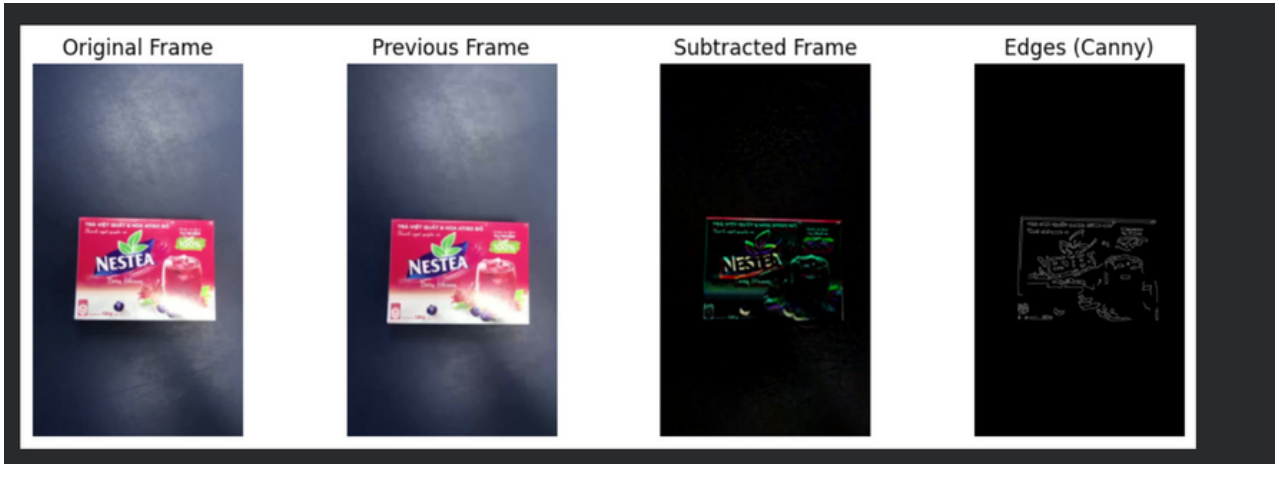
--> Benefit :

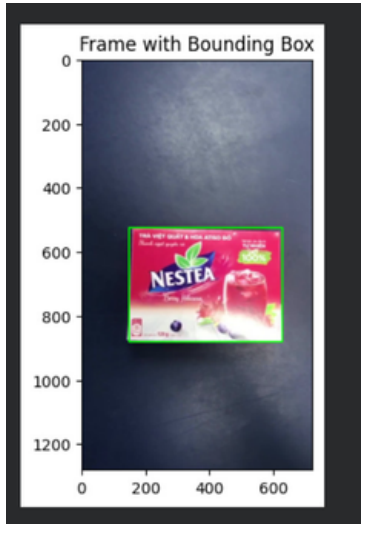
- Auto generate bounding boxes, training data
- Maybe lighter

Key point of this method : Image processing techniques to detect boxes

6.Improvement

```python
def create_bounding_box(frame, pre_frame):

    subtracted = cv2.subtract(frame, pre_frame)

    gray = cv2.cvtColor(subtracted, cv2.COLOR_BGR2GRAY)

    blurred_image = cv2.medianBlur(gray,9,0)

    min_threshold = 20
    max_threshold = 80
    edges_subtract = cv2.Canny(blurred_image, min_threshold, max_threshold)

    points = list(np.where(edges_subtract > 0))

    cv2.rectangle(frame, (min(points[1]), min(points[0])), (max(points[1]), max(points[0])), (0, 0, 255), 3)

    return frame
```





6.Improvement

- Object Tracking (Yolov5 + DEEPSORT, SORT)
- Quantization
- Ensemble Learning

Final words

- Learn to use, survey papers about CNN models : CenterNet, YOLO, ...
- Get familiar with the process of developing AI, object detection project end-to-end
- Teamwork ability, supporting each other

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THANK YOU !