

2022년 IoT기반 스마트 솔루션 개발자 양성과정



Programming : Python

14-Haar Cascades

담당 교수 : 윤 종 이

010-9577-1696

ojo1696@naver.com

<https://cafe.naver.com/yoons2022>



충북대학교 공동훈련센터

Haar Cascades

- 2001년, Paul Viola와 Michael Jones 제안
 - Rapid Object Detection using a Boosted Cascade of Simple Features
 - Positive Image와 Negative Image 를 다단계 함수를 훈련하는 기계학습 방식

| | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|
| 0.4 | 0.7 | 0.9 | 0.7 | 0.4 | 0.5 | 1.0 | 0.3 |
| 0.3 | 1.0 | 0.5 | 0.8 | 0.7 | 0.4 | 0.1 | 0.4 |
| 0.9 | 0.4 | 0.1 | 0.2 | 0.5 | 0.8 | 0.2 | 0.9 |
| 0.3 | 0.6 | 0.8 | 1.0 | 0.3 | 0.7 | 0.5 | 0.3 |
| 0.2 | 0.9 | 0.1 | 0.5 | 0.1 | 0.4 | 0.8 | 0.8 |
| 0.5 | 0.1 | 0.3 | 0.7 | 0.9 | 0.6 | 1.0 | 0.2 |
| 0.8 | 0.4 | 1.0 | 0.2 | 0.7 | 0.3 | 0.1 | 0.4 |
| 0.4 | 0.9 | 0.8 | 0.6 | 0.2 | 1.0 | 0.5 | 0.9 |

| | | | | | |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 0 | 1 | 1 | 1 |
| 0 | 0 | 0 | 1 | 1 | 1 |

=

SUM OF THE DARK PIXELS/NUMBER OF DARK PIXELS -
SUM OF THE LIGHT PIXELS/NUMBER OF THE LIGHT PIXELS

$(0.7 + 0.4 + 0.1 + 0.5 + 0.8 + 0.2 + 0.3 + 0.7 + 0.5 + 0.1 + 0.4 + 0.8 + 0.9 + 0.6 + 1.0 + 0.7 + 0.3 + 0.1)/18$

$(1.0 + 0.5 + 0.8 + 0.4 + 0.1 + 0.2 + 0.6 + 0.8 + 1.0 + 0.9 + 0.1 + 0.5 + 0.1 + 0.3 + 0.7 + 0.4 + 1.0 + 0.2)/18$

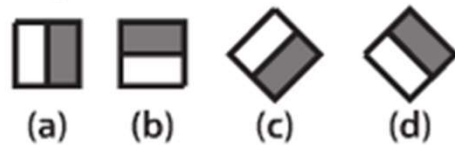
$0.51 - 0.53 = -0.02$



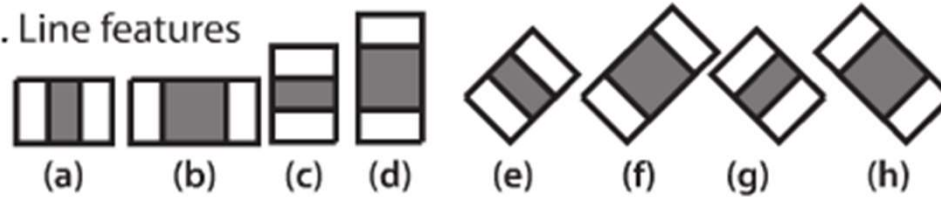
충북대학교 공동훈련센터

Haar Cascade features

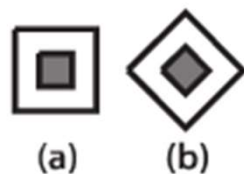
1. Edge features



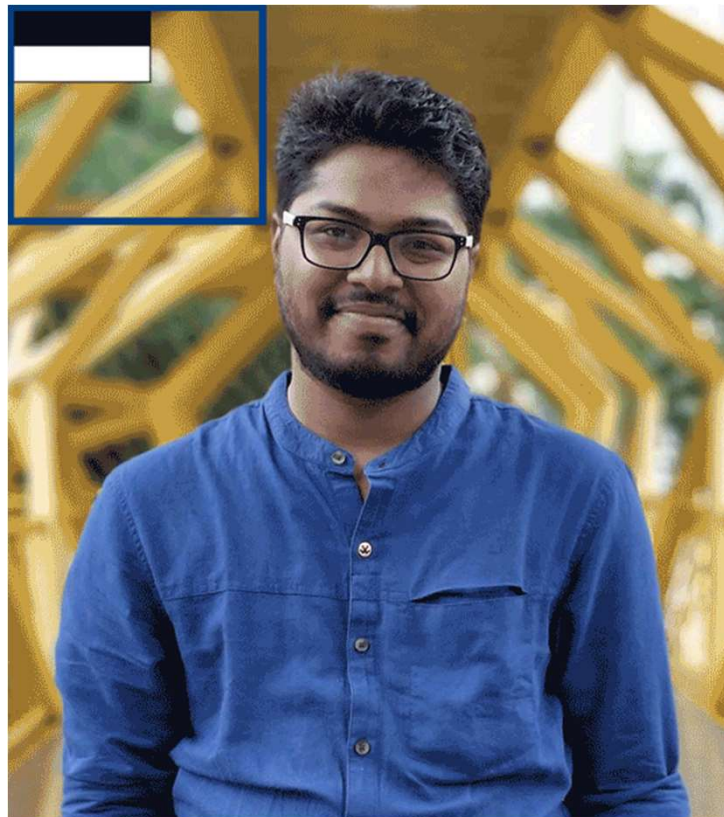
2. Line features



3. Center-surround features



Haar Cascade Detection



충북대학교 공동훈련센터

Feature-based Cascade Classifiers

- <https://github.com/opencv/opencv/tree/master/data/haarcascades>

| | | | | |
|--|--|--|--------------------------|---------------|
| alalek fix files permissions | | | ✓ f0ffc52 on 13 Apr 2020 | History |
| .. | | | | |
| haarcascade_eye.xml | some attempts to tune the performance | | | 8 years ago |
| haarcascade_eye_tree_eyeglasses.xml | some attempts to tune the performance | | | 8 years ago |
| haarcascade_frontalcatface.xml | fix files permissions | | | 15 months ago |
| haarcascade_frontalcatface_extended.xml | fix files permissions | | | 15 months ago |
| haarcascade_frontalface_alt.xml | some attempts to tune the performance | | | 8 years ago |
| haarcascade_frontalface_alt2.xml | some attempts to tune the performance | | | 8 years ago |
| haarcascade_frontalface_alt_tree.xml | some attempts to tune the performance | | | 8 years ago |
| haarcascade_frontalface_default.xml | some attempts to tune the performance | | | 8 years ago |
| haarcascade_fullbody.xml | Some mist. typo fixes | | | 4 years ago |
| haarcascade_lefteye_2splits.xml | some attempts to tune the performance | | | 8 years ago |
| haarcascade_licence_plate_rus_16stages.xml | Added Haar cascade for russian cars licence plate detection, 16 stage... | | | 7 years ago |
| haarcascade_lowerbody.xml | Some mist. typo fixes | | | 4 years ago |
| haarcascade_profileface.xml | some attempts to tune the performance | | | 8 years ago |
| haarcascade_righteye_2splits.xml | some attempts to tune the performance | | | 8 years ago |
| haarcascade_russian_plate_number.xml | Create haarcascade_russian_plate_number.xml | | | 7 years ago |
| haarcascade_smile.xml | fixing models to resolve XML violation issue | | | 4 years ago |
| haarcascade_upperbody.xml | Some mist. typo fixes | | | 4 years ago |



xml Down load

```
12213 lines (12202 sloc) | 333 KB
1 <?xml version="1.0"?>
2 <!--
3     Stump-based 20x20 frontal eye detector.
4     Created by Shameem Hameed (http://umich.edu/~shameem)
5
6     //////////////////////////////////////
7
8     IMPORTANT: READ BEFORE DOWNLOADING, COPYING, INSTALLING OR USING.
```

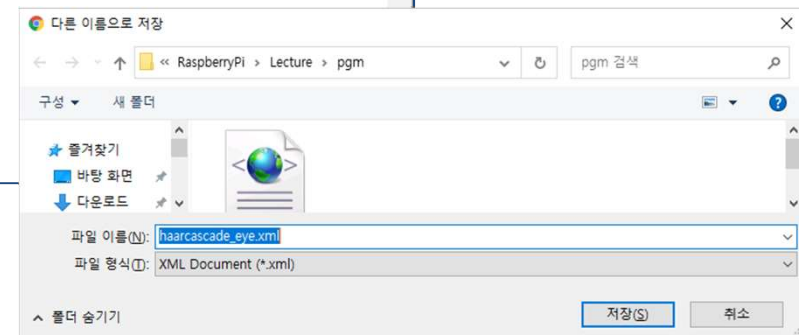
```
<?xml version="1.0"?>
<!--
    Stump-based 20x20 frontal eye detector.
    Created by Shameem Hameed (http://umich.edu/~shameem)

    //////////////////////////////////////

    IMPORTANT: READ BEFORE DOWNLOADING, COPYING, INSTALLING OR USING.

    By downloading, copying, installing or using the software you agree to this license.
    If you do not agree to this license, do not download, install,
    copy or use the software.
```

ctrl+s



충북대학교 공동훈련센터

Frontalface-default

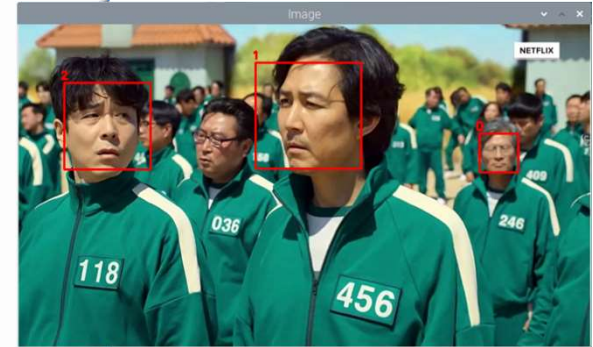
```
1 import cv2
2 import numpy as np
3
4 face_cascade=cv2.CascadeClassifier("haarcascade_frontalface_default.xml")
5
6 img=cv2.imread('squid_game.jpg')
7 gray=cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
8
9 faces=face_cascade.detectMultiScale(gray,1.2,5)
10 for(x,y,w,h) in faces:
11     cv2.rectangle(img,(x,y),(x+w,y+h),(0,0,255),1)
12
13 cv2.imshow('Image',img)
14 cv2.waitKey(0)
15 cv2.destroyAllWindows()
16
```

detectMultiScale(img, scaleFactor, minNeighbors, flags, minSize, maxSize)



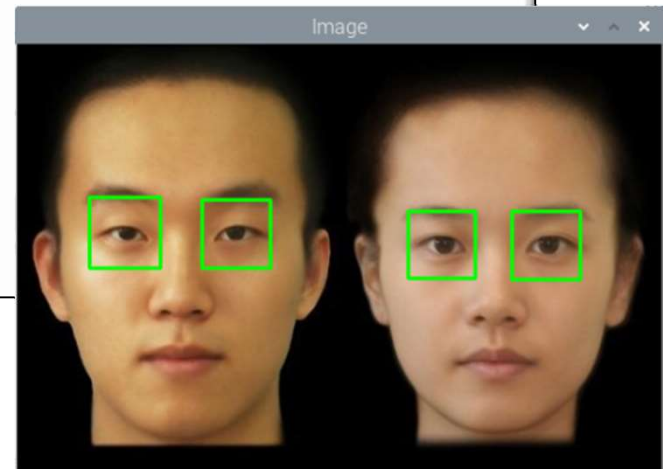
Frontalface-default-2

```
1 import cv2
2 import numpy as np
3
4 face_cascade=cv2.CascadeClassifier("haarcascade_frontalface_default.xml")
5
6 img=cv2.imread('squid_game.jpg')
7 gray=cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
8
9 faces=face_cascade.detectMultiScale(gray,1.2,5)
10
11 gray=cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
12 faces=face_cascade.detectMultiScale(gray,1.2,5)
13
14 count=0
15 for(x,y,w,h) in faces:
16     cv2.rectangle(img,(x,y),(x+w,y+h),(0,0,255),2)
17     cv2.putText(img,str(count),(x-5,y-5),cv2.FONT_HERSHEY_SIMPLEX,0.5,(0,0,255),2)
18     count=count+1
19
20 cv2.imshow('Image',img)
21 cv2.waitKey(0)
22 cv2.destroyAllWindows()
```



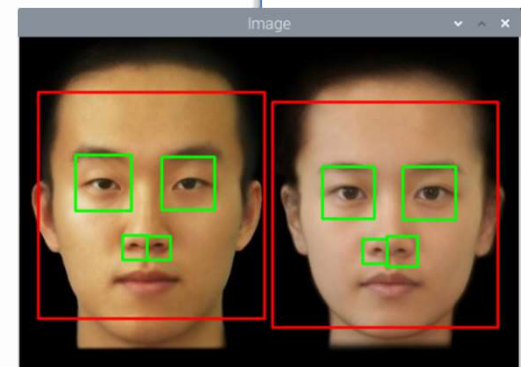
haarcascade_eye

```
1 import cv2
2 import numpy as np
3
4 eye_cascade=cv2.CascadeClassifier("haarcascade_eye.xml")
5
6 img=cv2.imread('Korean_Face.jpg')
7 gray=cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
8
9 eyes=eye_cascade.detectMultiScale(gray,1.2,5)
10
11 for(x,y,w,h) in eyes:
12     cv2.rectangle(img,(x,y),(x+w,y+h),(0,255,0),2)
13
14 cv2.imshow('Image',img)
15 cv2.waitKey(0)
16 cv2.destroyAllWindows()
17
```



Frontalface-default + eye

```
1 import cv2
2 import numpy as np
3
4 face_cascade=cv2.CascadeClassifier("haarcascade_frontalface_default.xml")
5 eye_cascade=cv2.CascadeClassifier("haarcascade_eye.xml")
6
7 img=cv2.imread('Korean_Face.jpg')
8 gray=cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
9
10 faces=face_cascade.detectMultiScale(gray,1.2,5)
11
12 for(x,y,w,h) in faces:
13     img=cv2.rectangle(img,(x,y),(x+w,y+h),(0,0,255),2)
14     roi_gray=gray[y:y+h,x:x+w]
15     roi_color=img[y:y+h,x:x+w]
16     eyes=eye_cascade.detectMultiScale(roi_gray)
17     for(ex,ey,ew,eh) in eyes:
18         cv2.rectangle(roi_color,(ex,ey),(ex+ew,ey+eh),(0,255,0),2)
19
20 cv2.imshow('Image',img)
21 cv2.waitKey(0)
22 cv2.destroyAllWindows()
```



실습

- 웃는 얼굴 찾기



충북대학교 공동훈련센터