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#10yen detect for Python2/3
#by takuya matsubara
from webob import Request, Response
import io
import picamera
import pygame
from pygame.locals import *
import math
import os.path

learnpixel = 64   #crop image width
learnarray = []
learnflag = 0   ←←←←学習モードの場合は１、認識モードの場合は０
learnmax = 5

WIDTH = 320       #picture Width
HEIGHT = 240      #picture Height
WHITE = (255,255,255)
BLACK = (0,0,0)
CYAN = (0,255,255)
RED = (255,0,0)
GREEN = (0,255,0)
BLUE = (0,0,255)

pygame.init()
dispsurf = pygame.display.set_mode((WIDTH*2, HEIGHT*2))
dispsurf.fill(BLACK)
pygame.display.set_caption('10yen detect (click to start)')
txtfont = pygame.font.Font('freesansbold.ttf', 32)
camera = picamera.PiCamera()
camera.resolution = (WIDTH,HEIGHT)
stream = io.BytesIO()
threshold = 12    #red value
threshold2 = 7    #crop size diff
threshold3 = 20   #score
sizemax = 50      #crop size max
sizemin = 20      #crop size min
skippixel = 3     #skip pixel

html = """
<img src="image.jpg"><br>Answer:%s yen<br><form method="post">
<input type="submit" name="button" value="RELOAD"></form>
"""

filename = "./learn.txt"        #learning file
exist = os.path.isfile(filename)
if exist==True:   #file exist
        array = pygame.PixelArray(dispsurf)
        for line in open(filename, "r"):    #load file  ←←←←学習ファイルの読み込み
                data = line.split(",")
                for i in range(len(data)):
                        idx = int(i / (learnpixel*learnpixel))
                        i2 = i % (learnpixel*learnpixel)
                        color = int(data[i])
                        learnarray.append(color)
                        x = (i2 % learnpixel)+(idx*learnpixel)
                        y = int(i2 / learnpixel)+(HEIGHT/2)
                        array[x+WIDTH][y+HEIGHT] = color
        del array
else:
        learnflag = 1

pygame.display.update()

html = """
<img src="image.jpg"><br>Answer:%s yen<br><form method="post">
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"""
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def count10yen():
        pygame.draw.rect(dispsurf, BLACK, (0,0,WIDTH,HEIGHT*2))
        array = pygame.PixelArray(dispsurf)

        #take a picture
        print('take a picture')
        stream.seek(0)
        camera.capture(stream,'rgb')   ←←←←カメラで撮影
        #convert   ←←←←2階調化
        for y in range(0,HEIGHT):
                for x in range(0,WIDTH):
                        stream.seek((x+(y*WIDTH))*3)   ←←←←カメラ画像の頭出し
                        r = ord(stream.read(1))      #red
                        g = ord(stream.read(1))      #green
                        b = ord(stream.read(1))      #CYAN
                        rv = int(r-((g+b)/2))    #red value   ←←←←赤色成分を算出
                        if rv<0 :rv=0
                        array[x+WIDTH][y] = (r,g,b)
                        if rv>threshold :array[x][y] = RED   ←←←←2階調化して画面表示
        #crop image   ←←←←画像の切り抜き処理
        x1 = [ 0, 1, 0,-1]
        y1 = [-1, 0, 1, 0]
        yen = 0
        for y in range(0,HEIGHT,skippixel):
                for x in range(0,WIDTH,skippixel):
                        diff = 0
                        for d in range(4):       #direction   ←←←←4方向の距離を測る
                                for size in range(sizemax):
                                        tx = x+(x1[d]*size)
                                        ty = y+(y1[d]*size)
                                        if (tx<0)or(tx>=WIDTH)or(ty<0)or(ty>=HEIGHT):break
                                        if array[tx][ty+HEIGHT]!=0:break #disable area
                                        if array[tx][ty]==0:break    #BLACK
                                if d>0:diff = diff+math.fabs(size-sizeold)   ←←←←距離のばらつきを算出
                                sizeold = size
                        if size>=(sizemax-1) or  size<sizemin :continue
                        if diff>threshold2:continue   ←←←←ばらつきを大きい場合は切り抜き失敗
                        dsize= size*2
                        xa = x-size   ←←←←切り抜く　X座標を算出
                        ya = y-size   ←←←←切り抜く　Y座標算出
                        if  learnflag==1 :         #learning   ←←←←学習用処理
                                if len(learnarray)>=(learnmax*learnpixel*learnpixel):continue
                                for ty in range(learnpixel):
                                        yb = ya+(ty*dsize/learnpixel)
                                        for tx in range(learnpixel):
                                                xb = xa+(tx*dsize/learnpixel)
                                                color = array[xb+WIDTH][yb]
                                                learnarray.append(color)

                                f = open(filename, 'w')   ←←←←学習ファイルに保存
                                for i in range(len(learnarray)):
                                        if i>0 :f.write(',')
                                        f.write(str(learnarray[i]))
                                f.close()
                                print("(learning) save"+str(len(learnarray))+"bytes")
                                for tx in range(dsize):
                                        for ty in range(dsize):
                                                array[xa+tx][ya+ty+HEIGHT] = CYAN     #disable area
                                continue

                        #matching   ←←←←認識の処理
                        idx = 0
                        scoremax=0
                        while(idx < len(learnarray)):
                                score = 0
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                                diff = 0
                                for ty in range(learnpixel):
                                        yb = ya+(ty*dsize/learnpixel)
                                        for tx in range(learnpixel):  ←←←←カメラと学習データの色を比較する
                                                xb = xa+(tx*dsize/learnpixel)
                                                color = array[xb+WIDTH][yb]  ←←←←カメラ画像のカラーコード
                                                r = (color & 0xFF0000)>>16
                                                g = (color & 0x00FF00)>>8
                                                b = (color & 0x0000FF)
                                                color2 = learnarray[idx]  ←←←←学習したカラーコード
                                                r2 = (color2 & 0xFF0000)>>16
                                                g2 = (color2 & 0x00FF00)>>8
                                                b2 = (color2 & 0x0000FF)
                                                diff = diff + math.fabs(r-r2)  ←←←←赤色の絶対値
                                                diff = diff + math.fabs(g-g2)  ←←←←緑色の絶対値
                                                diff = diff + math.fabs(b-b2)  ←←←←青色の絶対値
                                                idx = idx+1
                                score = 100-(diff / (learnpixel*learnpixel))    ←←←←  一致した得点
                                if score > scoremax : scoremax=score

                        print("x="+str(x)+" y="+str(y)+" score="+str(scoremax))
                        c = BLACK
                        if scoremax > threshold3:  ←←←←  得点が一定より大きい場合は10円玉と判定する
                                c = WHITE
                                yen = yen+10  ←←←←お金の金額を10円足す
                                for tx in range(dsize):
                                        for ty in range(dsize):
                                                array[xa+tx][ya+ty+HEIGHT] = CYAN     #disable area
                        for i in range(dsize):   ←←←←切り抜いたワクを表示
                                array[xa+i+WIDTH][ya+0] = c
                                array[xa+i+WIDTH][ya+dsize] = c
                                array[xa+0+WIDTH][ya+i] = c
                                array[xa+dsize+WIDTH][ya+i] = c
        del array
        #print text
        txtdat = str(yen)+" Yen"
        if  learnflag==1 : txtdat ="learning"
        txtSurf = txtfont.render(txtdat, True, WHITE, BLUE)
        txtRect = txtSurf.get_rect()
        txtRect.topleft = (WIDTH , HEIGHT)
        dispsurf.blit(txtSurf, txtRect)
        pygame.display.update()
        return yen

class WebApp(object):
        def __call__(self ,environ ,start_response):
                req = Request(environ)
                if req.path=='/image.jpg':#response jpeg file
                        camera.capture('image.jpg')
                        bin_data = open('image.jpg', 'rb').read()
                        resp = Response(bin_data ,content_type='image/jpeg')
                elif req.path=='/':        #response html file
                        count = count10yen()
                        resp = Response(html % count)
                else:
                        resp = Response() #error

                return resp(environ, start_response)

application = WebApp()

if __name__ == '__main__':
        from wsgiref.simple_server import make_server
        port = 8080
        httpd = make_server('', port, application)
        print('Serving HTTP on port %s...' % port)
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try:
        httpd.serve_forever()
except KeyboardInterrupt:  #Ctrl+C
        pygame.quit()
        camera.close()
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