Cigarette Butt Detection

Algorithm

1. Read and show image (use one white cigarette image and one orange cigarette as example)
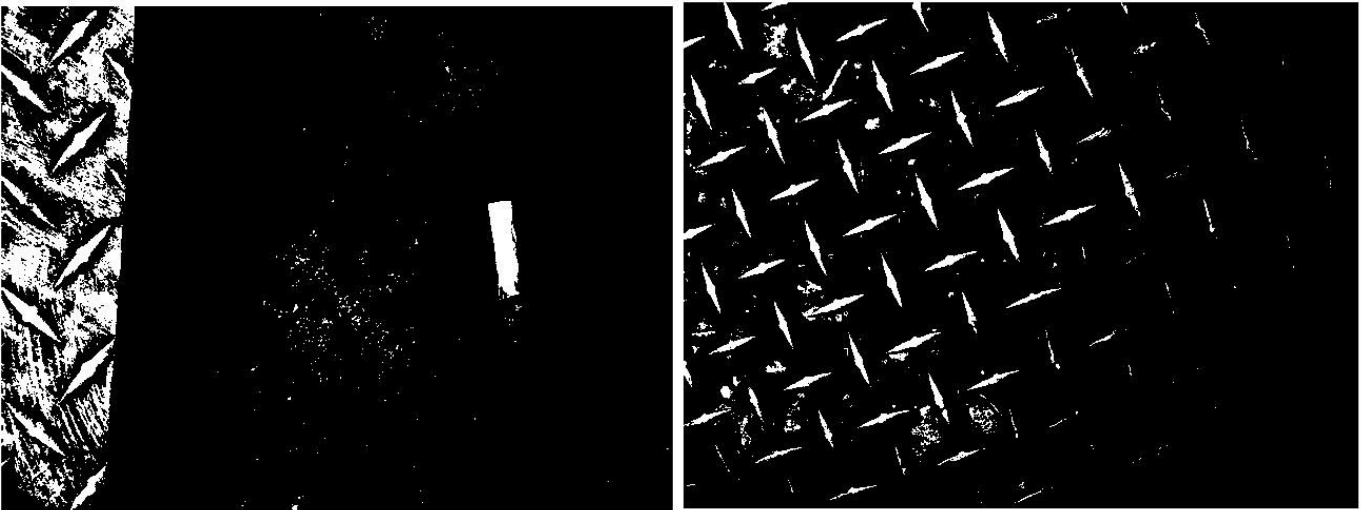

2. Turn image into two binary images where the color is close to white or orange using functions below

   Function

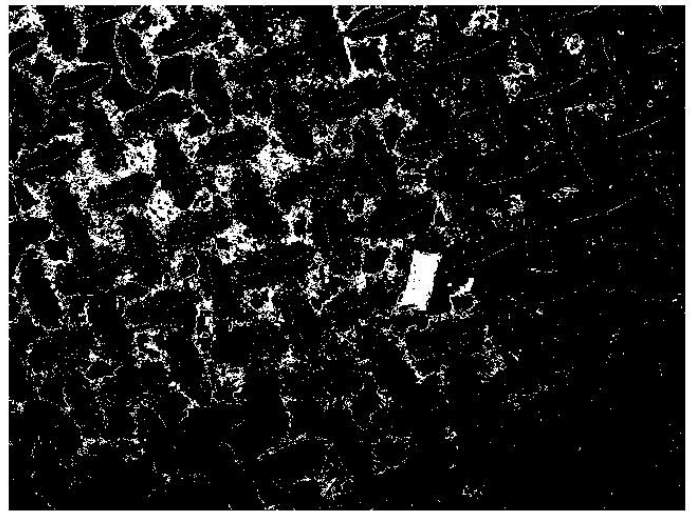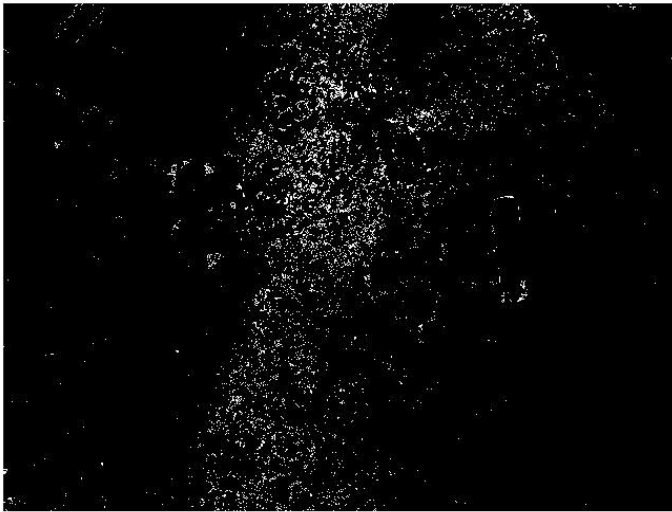   like_white: RGB all larger than 200 will be consider as white

   rgb(200,200,200) →　　　← color brighter than this will be considered white

   Function

   like_oragne: R:140-230 G: 90-190 B 40-140 will be consider as orange

   rgb(140,90,40)→　　　rgb(230,190,140)→　　　←color between these will be considered orange

3. If the function like_white can find less than 200 pixels,
   picture is not bright enough,
   try to use hsv and find high value (>0.6) and low saturation points (<0.2)
4. Use imfill to fill small hole for the objects in binary image
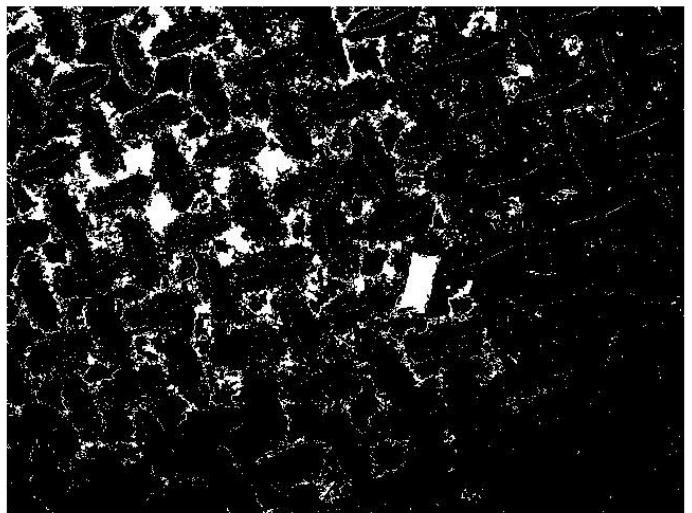
5. Use bwareafilt to extract objects with specific area size
   (800-2000 pixels for white cigarette and 470-2000 pixels for orange cigarette)

6. Use regionprops to calculate the properties of remaining objects in binary image
   'BoundingBox' is for the purpose of drawing rectangles for the location of cigarette butt
   'MajorAxisLength' is the length of the longer edge of object detected
   'MinorAxisLength' is the length of the shorter edge of the object detected
   'Area' is the area of the object detected
7. For each object detected,
   check if the ratio of 'MajorAxisLength' and 'MinorAxisLength' is larger than 1.9
   (number set by taking the smallest ratio found in sample image).
   If the ratio is larger than 1.9, it is a rectangle object not a square object.
8. For each object detected,
   check if 'Area' divided by the product of 'MajorAxisLength' and 'MinorAxisLength' has the ratio larger than 0.6
   (number set by taking the smallest ratio found in sample image).
   If the ratio is larger than 0.6, the pixels fill at least 60% of the rectangle which means it has a higher chance of being a rectangle but not other shape.
9. If everything goes through, draw a rectangle on the original image.

What I tried

1. turn the image into grayscale and adjust the image's contrast using imadjust
   - failed: grayscale is hard to distinct actual white color
2. try imadjustn again on original color image
   - failed: able to distinct some white cigarette on orange background, but only when objects in the image other than cigarette are dark enough or it won't work
3. use roicolor to select region of interest based on color
   - works on Cig13 but failed on Cig_on_Orange1, contrast is too close
4. use imadjustn first then roicolor
   - not it works on Cig_on_Orange1, but failed on Cig13 because some white spot on leaves become too bright
5. write functions to convert RGB image into binary image, check the positions of white or orange
6. the rest will be the functions I use in algorithm above and test on different threshold to achieve the final program

Why it works

The idea is that all cigarettes are either white or orange and have the similar size in the photo, so we can extract white and orange color and distinct the size to appropriate size. Then we can use the regionprops to calculate the property of the cigarettes which will usually be a rectangle. Also, the cigarette butt will not usually be square as there is a limit how much a cigarette can smoke which will still be rectangle after finished.

Limitations

- The program will only find cigarettes that are in the specific range of size(800-2000 pixels for white cigarettes or 400-2000 pixels for orange cigarettes)

The cigarettes in the left image are too small to detect.

- I trade in small cigarettes to get less noise, so the program will not catch small bright object that is not cigarette but reflection of leaves or rocks

- The program will only find cigarettes that are in the specific range of color (RGB all larger than 200 or R:140-230 G: 90-190 B 40-140)

 ← color brighter than this

 ←color between these

- The program will not catch the cigarette if it is partially covered by shade or other object
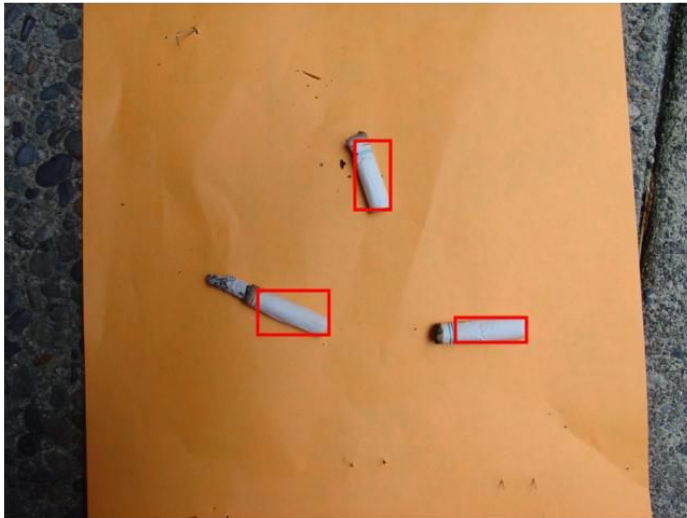

The cigarette at the left up corner is partially covered, and another cigarette beside is stuck in the rocks which is partially covered as well. Therefore, they are not detected

- If the cigarette has two color, it may be detected as two cigarette

Other results

Journal

bigger contrast using imadjust
black and white is hard to distinct white color
try on color image
increase contrast allow setting on higher threshold to distinct white cigarette butt

test on Cig_on_Orange1.JPG
imadjustn(image,[0.5,0.6],[]) on image
then turn to greyscale
using threshold of 250/255
canny edge detection 0.1, 10
able to find three cigarette

test on Cig13.JPG
not working
try finding color where is close to white
use roicolor to find index from 250 to 255
able to find cigarette
re-test on Cig_on_Orange1.JPG
not working
use imadjustn first then roicolor
able to find cigarette
but not working on Cig13.JPG

have to extract white color in color image not greyscale
create function with RGB > 250
works with Cig13.JPG not Cig_on_Orange1.JPG

test on Cig13.JPG
extract white color
use imfill to fill holes
use bwareafilt to filter area that is between 1000 to 2000
success
test on Cig07
catch only 1 butt
change bwareafilt to 800 to 2000
success on both Cig13 and Cig07

try to print location and draw a rectangle around the cig butt
regionprops with property "BoundingBox"
rectangle with the result given by regionprops

white color on Cig_on_Orange1 is not bright enough to use RGB to check if they are all >200
try using hsv color to find low saturation (0.2) and high value (0.6)
success

test on cig03, find object that is not cig butt
filter out using perimeter of regionprops that is larger than 300 to find closer to rectangle object

Success: Cig03, Cig07, Cig09, Cig13, Cig_on_Orange1

try on orange color butt
change the function of extracting white color
find R>170 and 140<G<200 and 60<B<150
success on cig05

use disp() and sprintf() to print location for each cig butt

use MajorAxisLength and MinorAxisLength ratio from regionprops to filter out square like object

success on cig08

not success cig01
cig too small

Reference:

CMPT 412 - Professor: Brian Funt