TTK4255 Course Work 1:
Image Processing

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Part 1 - Theory Questions

Course Work 1 - Andreas Haugland

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Part 1

1) The following are point operators:

c) Brightness and contrast adjustments

2) The effects are sharpening of the image.

3) $g(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{\left(-\frac{x^2}{2\sigma^2}\right)}$

a) Half width h such that the value of g outside the window is less than ε

I) $X = h + 1 < \varepsilon$

II) Solve $g(x) < \varepsilon$ for x:

$$\Rightarrow e^{-\frac{x^2}{2\sigma^2}} < \sqrt{2\pi}\sigma\varepsilon \Rightarrow \frac{-x^2}{2\sigma^2} < \ln\left(\sqrt{2\pi}\sigma\varepsilon\right)$$

$$-x^2 < 2\sigma^2 \ln(\sqrt{2\pi}\sigma\varepsilon)$$

$$x^2 > -2\sigma^2 \ln(\sqrt{2\pi}\sigma\varepsilon)$$

$$x > \sqrt{-2\sigma^2(\ln(\sqrt{2\pi}) + \ln(\sigma\varepsilon))}$$

$\ln(\sqrt{2\pi}) + \ln(\sigma\varepsilon) < 0$, so the expression under the root is > 0

III) $h + 1 > \sqrt{-2\sigma^2(\ln(\sqrt{2\pi}) + \ln(\sigma\varepsilon))}$

b) Inserting $\varepsilon = \frac{1}{256}$ and $\sigma = 3$ we get

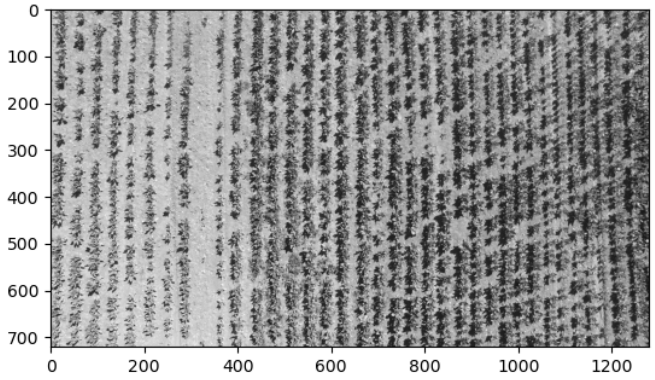
$x = h + 1 > 7.968\overline{5}$

Part 2 - Basics

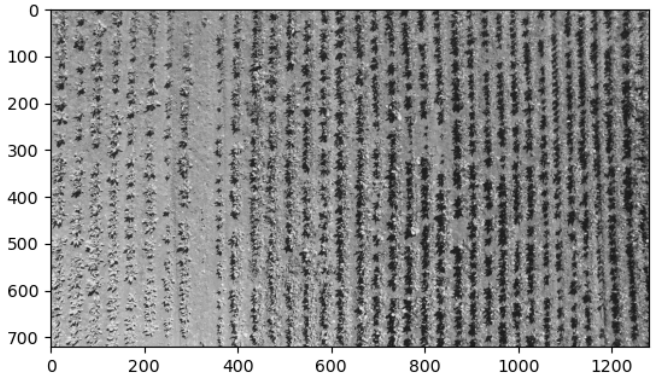
a) Task 2.1 Loading the image in python and returning its width and height yielded the result (width, height) = (1280, 720).

b) Task 2.2 and 2.3 The green channel is [:, :, 1]. Figure c) illustrates the non-normalized color channels.

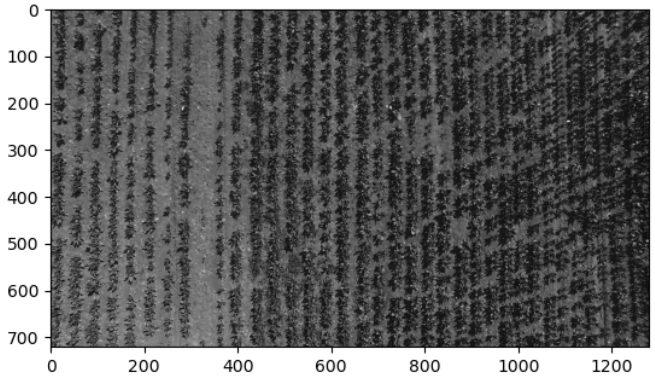
As can be seen from the histogram and the comment in the next task, it is not possible to find a single threshold that isolates the pixels of the sugar beet leaves, as it is hard to differ the luminance and hue of the colour in the green channel, i.e we can't determine greeness in this way. The histogram also illustrates two peaks; I'm not quite sure what this signifies, but my guess is that this supports the claim that luminance and hue of the colour are causing confusing.



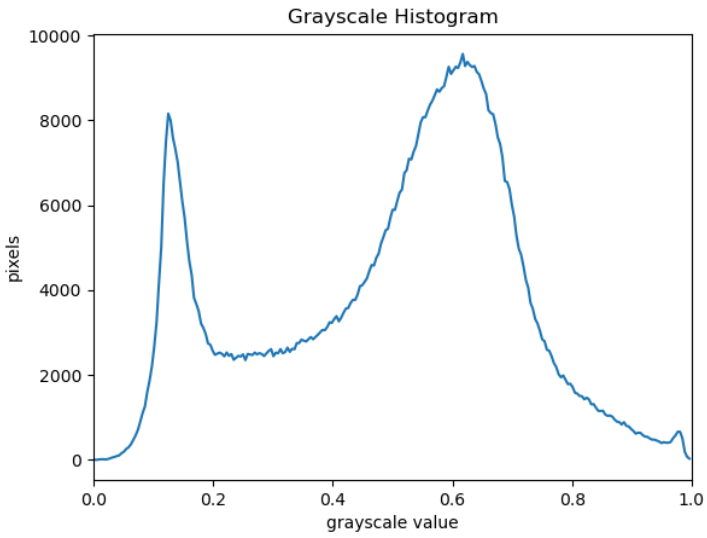
(a) [:,:,0]



(b) [:,:,1]



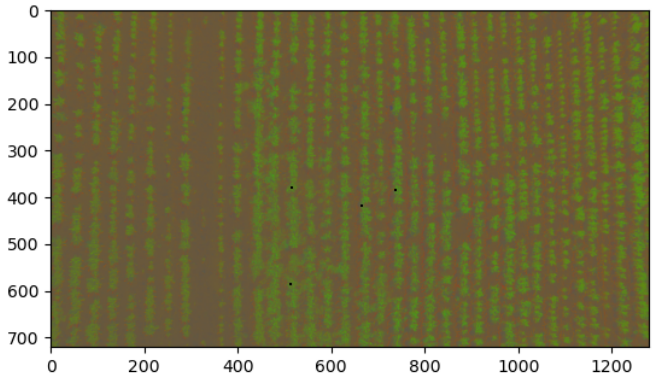
(c) [:,:,2]



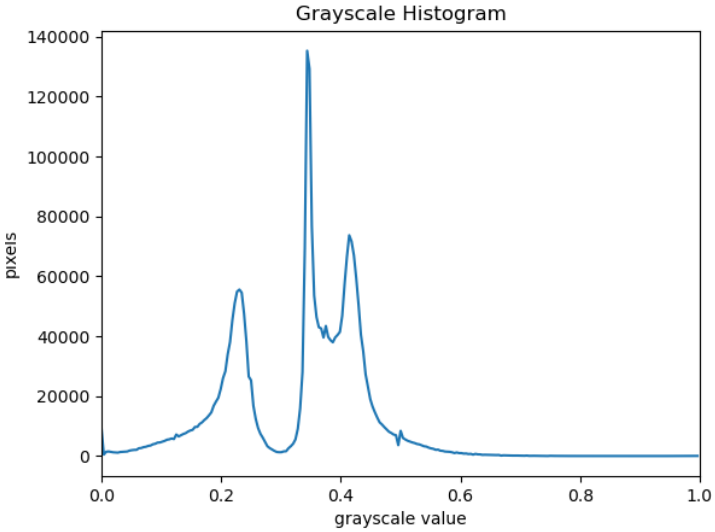
(d)

Figure 1: Grayscaled, unnormalized image channels with grayscale histogram

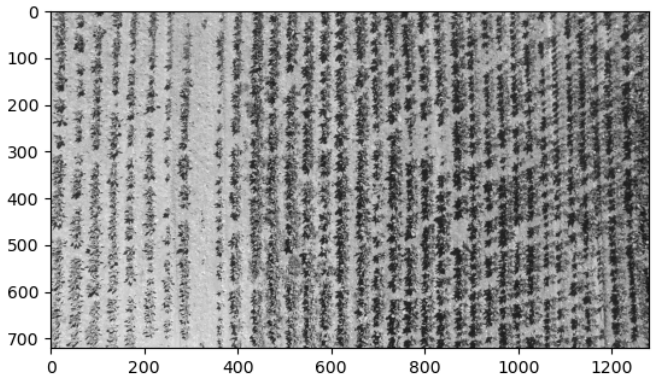
c) Task 2.4 and 2.5 Figure **??** displays the result after normalizing the rgb image. The histogram in figure displays that the threshold should be somewhere around 4-4.5. Setting it to 4.3 we get the result in subfigure



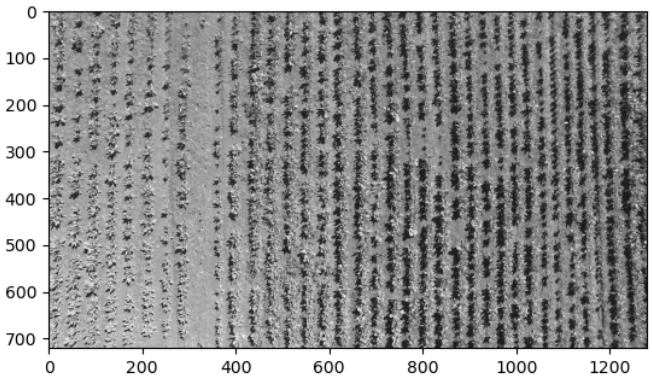
(a) [:,:,0]



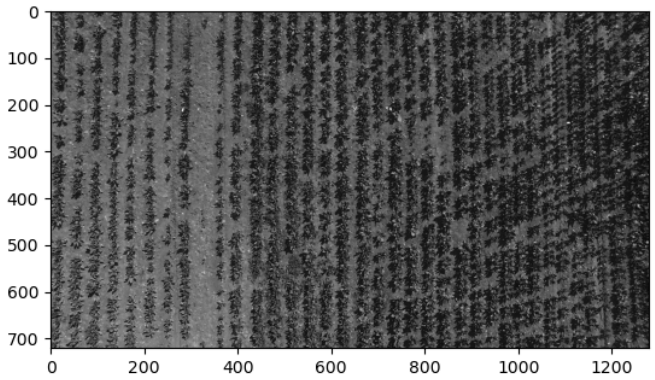
(b) [:,:,1]



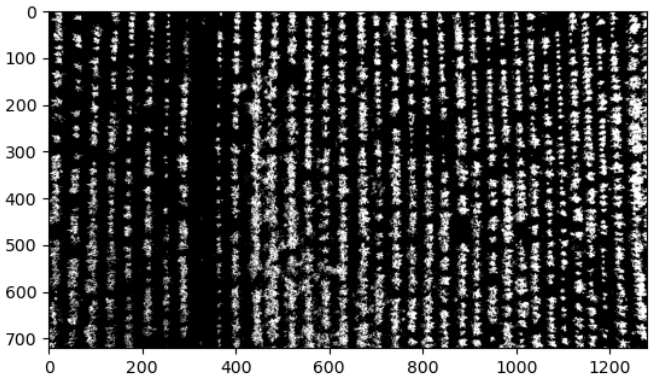
(c) [:,:,2]



(d)

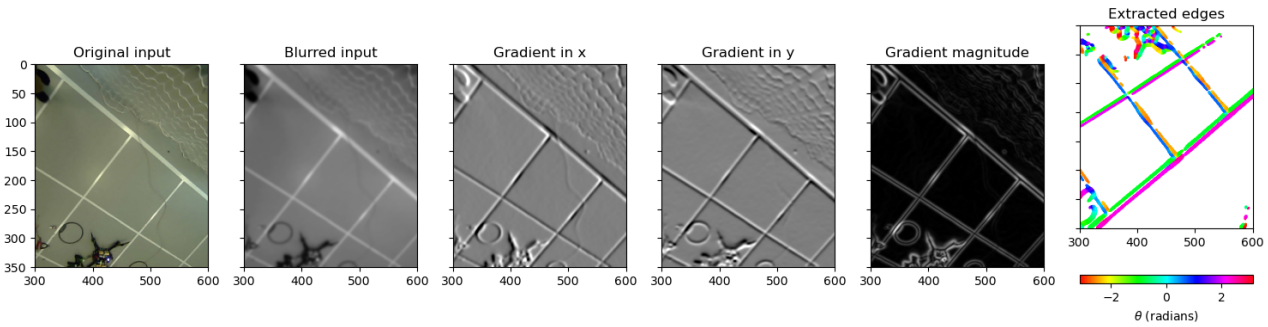


(e) [:,:,2]



(f) Thresholded image, t = 0.43

Figure 2: Normalized rbg-image with grayscale histogram, single colour channel and normalized thresholded image



1 Part 3 - Edge detection

a) Task 3.1 - 3.5 Figure **??** displays the result of the implemented code.

b) Task 3.6 - 7 The optional self study tasks where not performed

References

[1] Richard Szeliski: *Draft (2020) Computer Vision: Algorithms and applications 2nd edition*

[2] Some image processing in Python: *https://datacarpentry.org/image-processing/07-thresholding/*

[3] Source code for the report can be seen in my private git repo: *https://github.com/aHaugl/TTK4255-Robotsyn*