Image Processing and Computer Vision

REPLICATING ALGORITHM AN ADAPTIVE ALGORITHM FOR GREY IMAGE EDGE DETECTION BASED ON GREY CORRELATION ANALYSIS

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Abstract:

Engineering Psychology, Group 881
Electronic Systems, Aalborg University
`18g881@es.aau.dk`

1 Introduction

The purpose of this mini project in Image Processing and Computer Vision, is to find a article which use a algorithm in some area of computer vision, and try to replicate their results. The chosen article is (**Baoming2016**). The article is focused on optimizing a grey image edge detection algorithm which is based on grey correlation analysis. The optimization is based in making the thresholding of the edge detection adaptive. The goal of the improved algorithm is to get a end result with fewer falls positive edge detected, and better continuity in the detected edges. Figure 1 is a figure from (**Baoming2016**) which shows the result using the optimized algorithm, compared to the original grey correlation analysis algorithm. On Figure 1 the image in the bottom right corner is the result from the improved algorithm, while the other images is a result of different thresholds and operators.

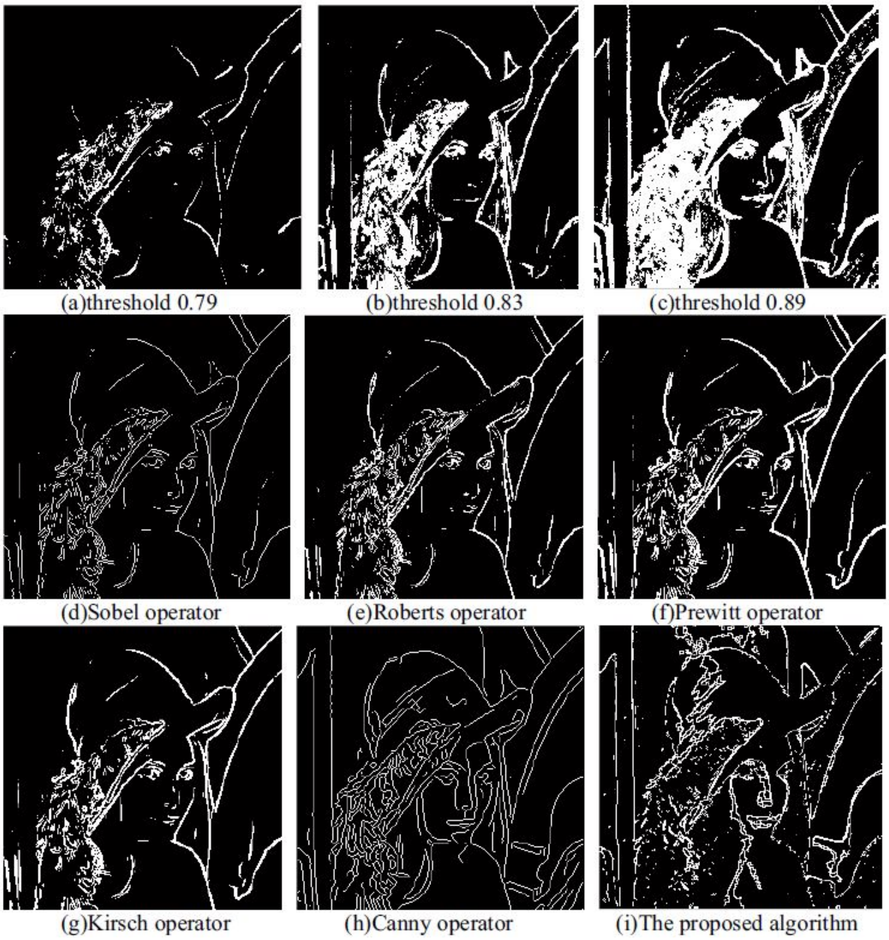

Figure 1

The article is step vise going through the mathematics of the improved algorithm and trying to explain how the step works. A test of the algorithm is conducted and some of the results from the steps are shown in Figure 2. The step vise changes seen at Figure 2 is also therefore the also the goal for this mini project.

(a)Original image (b)Grey relational image (c)The middle image (d)The result image

Figure 2

2 The algorithm step by step

In this section will be focused on describing the different steps of the algorithm and how the different steps has been transformed into code. The coding is made in MATLAB. All the step are taking in acount that we have a grey scale image of dimensions of m times n.

2.1 Step 1

The first step step is focusing on **Grey Absolute Correlation Degree Model**. The first equation K_0 is the reference sequence and K_i is the comparative sequence. This means that K_0 is the first row of pixels, while K_i is all the pixels.

$$K_0 = K_0(s), s = 1, 2, ..., n \tag{1}$$

$$K_i = K_i(s), s = 1, 2, ..., n, i = 1, 2, ..., m \tag{2}$$

hereafter we initialize the data. This is done by dividing each row with the first pixel of the row. Which is seen in the two equations below.

$$K_0' = \frac{K_0(s)}{K_0(1)}, s = 1, 2, ..., n \tag{3}$$

$$K_i' = \frac{K_i(s)}{K_s(1)}, s = 1, 2, ..., n, i = 1, 2, ..., m \tag{4}$$

Then we calculate the absolute correlation coefficient between K'_0 and K'_i, which is done with the following equation.

$$r(K'_0(s), K'_i(s)) = \frac{1}{1 + |(K'_0(s+1) - K'_0(s)) - (K'_i(s+1) - K'_i(s))|} \tag{5}$$

After calculation the coefficient, we calculated the absolute degree of it.

$$R(K_0, K_i) = \frac{1}{n-1} \sum_K = 1^n - 1r(K'_0(s), k'_i(s)) \tag{6}$$

2.2 Step 2

This step is focused on **Grey correlation degree image**

2.3 Step 3

This step is focusing on the **Adaptive Threshold Calculation Based on Human Visual Characteristics**. The purpose of this step is to make the threshold dependent of how sensitive the human eye is to the level of grey scaling. This is based on another study, showing that the human eye is more sensitive to some levels of grey. This results in three differential equations that take the mean value of the 9 pixels described subsection 2.2. Depending on the mean value only one of the following differential equations are used.

$$x\epsilon[0, 48]\frac{d_y}{d_x} - \frac{3y}{x} + 30 = 0 \tag{7}$$

$$x\epsilon(48, 206]\frac{d_y}{d_x} - \frac{3y}{x} + 0.081397x - 3.325108 = 0 \tag{8}$$

$$x\epsilon(206, 255]\frac{d_y}{d_x} - \frac{2y}{x} + 0.003193x^2 - 595.896710 = 0 \tag{9}$$

The values from the the differential equations is the stored in a new matrix T. All values in T which are between 0 and 1 is kept, while for all values greater then 1 are the integer part is removed, so that they also are between 0 and 1. The values are then stored in a final threshold matrix T_1

3 Hypothesis

When conducting an experiment it is important to specify what exactly we want to measure. As it has already been mentioned, the focus of this study is the perception of the surface of the five dices in comparison with each other. As such, the H0 hypothesis can be formulated as:

> *The surface of the dice are perceived equally for each die.*

Through hypothesis testing, it will take a p-value greater than 0.05 to accept this assumption. If the P-value is lesser than 0.05 there will be strong evidence against the H0 hypothesis, which means that the dices would be perceived differently.

4 Results

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5 Analysis

After constructing the script and executing it, the following findings were made:
0 WST
1 MST
5 SST
A p-value of 0.1414.
The p-value is above 0.1 which indicates that the preference tree model is not significant worse than a theoretical perfect model. In a preference tree model there is both scale values for the stimuli presented in the study, and the attributes the tree is made with. The scale values of the attributes is used to illustrate the perceived difference of how big a health risk the substance is, eg. longer branch bigger perceived risk. On Figure 3 the preference tree is illustrated with the scale values, and the numbers at each branch is a indicator for the belonging attribute. The green line is modified so it is three times shorter than it normally would be the red is also modified, but it is shortened ten times. This is done to ensure that all the trees proportions are viewable at the same time.

[1] FiXme Note: Write Results

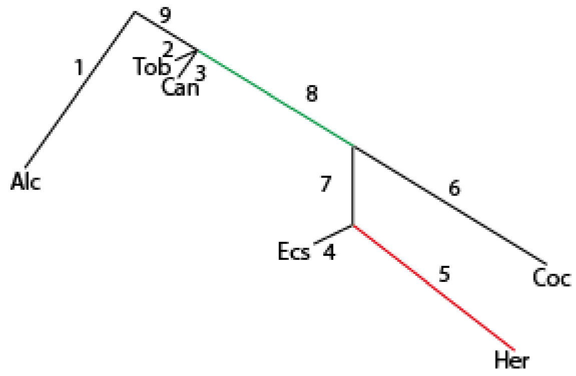

Figure 3

From the tree it's clear that the different attributes have different effects on how big the perceived health risk is. With these results it's found interesting to investigate how the attributes compare with each other. To compare the attributes the scale values for every branch of the tree is plotted, with the belonging 95% confidence interval, see Figure 4.

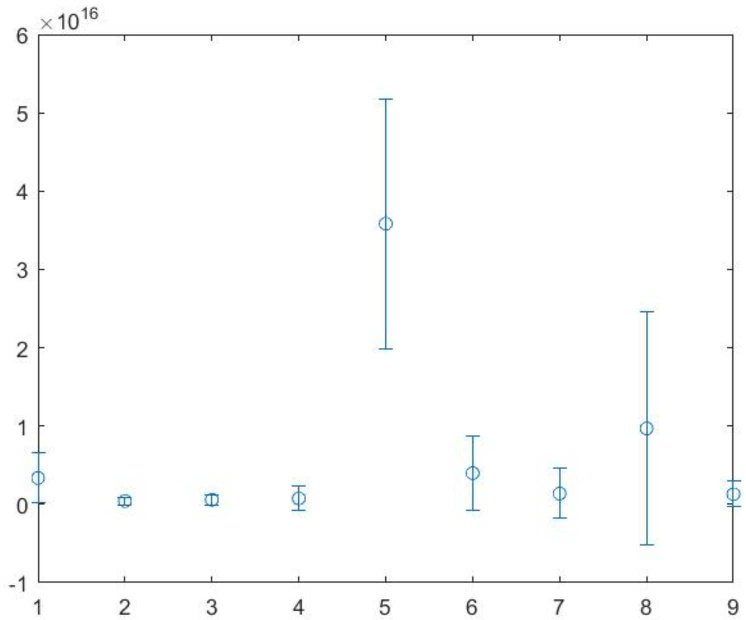

Figure 4

It's found that the only attribute that is significant different from the others is the cocaine, which is the one that have cocaine at the end.

6 Discussion

The Tree illustrated at Figure 3 uses attributes at every branch, which is compared in Figure 4. The structure of the tree is build up so the stimuli are sorted into different categories of attributes. With alcohol being the only drinkable substance it have it's own attribute, which is number 1. The other substances goes from the attribute number 9, which is the non drinkable substances. From 9 the attributes 2 and 3 goes down to tobacco and cannabis. Attribute 2 indicates social acceptable and legal substance, while attribute 3 indicates social acceptable but illegal substance. The 8'th attribute indicates non-social acceptable and illegal substances. The 6'th attribute indicates that the substance is a common party drug, hence cocaine, while the 7'th attribute is for more hard drug, where 4 goes to ecstasy is and 5 goes to heroin.

7 Conclusion

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[2] FiXme Note: Write Conclusion