**Project Report**

**TOPIC 1: INTENSITY TRANSFORMATIONS & SPATIAL FILTERING**

**Image Processing (BEJ42903)**

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# 1. Introduction

Everybody has already been in the situation, where a picture was taken of themselves or of a sight during vacation. But afterwards the pictures turn out to have flaws, like being too dark or need smoothing. But now you can not share the pictures with family or friends. This project is addressing this issue by establishing an android application to process the images with flaws.

The implemented methods get described in the lecturer paper “INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING” from Gonzalez, R. and Woods, R.. “Intensity transformations operate on single pixels of an image for tasks such as contrast manipulation and image thresholding. Spatial filtering performs operations on the neighborhood of every pixel in an image. Examples of spatial filtering include image smoothing and sharpening“. The methods can be very useful for every person, to help improve their own pictures and the application will do the work.

This report is the documentation of the app and its development. It will treat the transformation techniques, the development tool, an user instruction and an analyzation of its output.

# 2. Transformation Technique

The following chapter will describe the applied transformation techniques. The android application does one transformation of each of the topics, one intensity transformation and one spatial filter method.

## 2.1 Intensity Transformation

Gupta, B. and Agarwal, T. K. describe the need of an intensity transformation in their paper “New contrast enhancement approach for dark images with non-uniform illumination”. They state that pictures can be taken in in not optimal light conditions, that can lead to pictures that are too dark. Hussain, K. and others state in their research paper “A histogram specification technique for dark image enhancement using a local transformation method”, that wrong lightning can also be a result of a wrong capturing device operation. They say that an enhancement is important that the picture is still worthy to keep. As first solution they suggest histogram stretching, as it is one of the most common ways. But later they argument that it has several downsides for pictures which have been too dark and need brightening. The first issue is that low intensity pixels are at danger of being merged. This leads in a contrast lost in this intensity area. A second issue can be that pictures can start to look unnatural after the transformation, because of a shifted contrast. This is why the development team has opted to implement a transformation that uses addition. This will brighten the picture, not merge low level intensities and not shift the contrast.

While during histogram stretching a new value is assigned to each pixel according to the stretching that took place, based on the histogram analyzing, for addition transformation a certain value gets added to every pixel intensity value. If the value reaches the maximum intensity value, it can not increase anymore. This is called clipping. To avoid it the user can decide on its own how much brightening is needed.

## 2.2 Spatial Filter

For spatial filtering the team chose the concept of the average filter. The concept is described in Li, T., Wang, J. and Yao, K. describe in their paper “Visibility enhancement of underwater images based on active polarized illumination and average ﬁltering technology”. Furthermore, it gives good insight into problems of image processing of underwater-pictures and how they need to be treated.

One of the biggest issues while taking photos underwater is the environment, the water. It has many particles that reflect light. That is why the picture consists of the light rays that hit the lens directly and of light rays that hit the lens through reflection. The goal of the paper’s processing process.is to eliminate the reflected light from the picture. Only then you can really see what the environment or a certain object looks like.

The average filter is used to approximate the backscattered light. It is used as an image blur filter. They are describing the process of averaging in putting a window of certain size over each pixel and its neighbors and then calculating the average value of it. For their special usage, they describe a coding method that increases the calculation speed. It is basically achieved by moving the window by one pixel and only remove the outside pixel, the others stay in the list, used for calculation. As they are already summed up and can be reused.

We assume that the standard user of the app is not doing underwater photos. In spite of that the filter is an important feature for the application. It is used as blur filter. The usage is simpler for this, as it can be used directly on the pictures, without further processing. It is needed for removing unwanted noise. While analyzing the sample pictures, it was clear that there are noise problems. For the implementation it was decided to use an average filter that uses a 5x5 mask and also no zero padding used. The mask size was determined after some test with different size masks to the sample pictures of the progress report.

# 3. Development Software

# 4. Application Instruction

# 5. Picture Analysis

## 5.1 Intensity Transformation

## 5.2 Spatial Filter

# 6. References

Gonzalez, R. and Woods, R., *Digital Image Processing*, 4th edition, 2018

Gupta, B. and Agarwal, T. K., *New contrast enhancement approach for dark images with non-uniform illumination*, Jabalpur, Elsevier, 2017

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Hussain, K. and Others, *A histogram specification technique for dark image enhancement using a local transformation method*, Dhaka, Springer Open, 2018