Technology
Arts Sciences
TH Köln

Project Documentation

Interactive Lighting Detector

written by

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Image Processing in SS 2017

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2 State of the Art

Laura

In the following sections the basic scientific knowledge to understand the *Lighting Detector*, whose functionality is explained in section 4, is presented.
A general introduction to image forensic is given in section 2.1. Furthermore, other approaches using light vectors to detect image manipulation are shortly presented in section 2.2.

2.1 Image Forensic

Laura

In [5] the authors claim image forensic to become more important over the years. Furthermore, they divide the field in two approaches. First of all image forensic can be used to identify the recording device of an image. This can, inter alia, be done by taking sensor imperfections, like for example pixel defects, or the lens aberration of the camera into consideration.
The second field of interest is the detection of image forgery [2]. Besides of using the camera response function there can be other details in the image which can be informative whether an image is real or a forgery. For example the light situation in an image must be consistent. This can be proofed by calculating light vectors in various points in the image. The *Light Detector* is using exactly this method (compare section 4). Related approaches are described briefly in section 2.2.

2.2 Related Approaches

Laura

The *Lighting Detector* was implemented according to the paper by Johnson and Farid [3]. The foundation of their assumptions where set in 2001 by the publication of Nillius and Eklundh on an "*automatic estimation of the projected light source direction*" [6]. Where as the earlier theory is taking three dimensional surface normals to determine the light vectors pointing into the direction if the light source, the newer approach by Johnson and Farid uses only one image, and therefore two dimensional surface normals, to achieve the same goal.
An other related approach, which is also presented by Johnson and Farid estimates the three dimensional light direction from the light's reflections in the eyes of human. Therefore they determine the light vector by using the surface normal and the view direction of the person [4].

Hast du noch andere Ansätze gefunden die enen ähnlichen Ansatz verfolgen??? Alle paper die ich sonst gefunden habe, fahren einen anderen Ansatz.

3 Materials

Laura

The following sections describe the resources and tools required for the completion of the project. Furthermore, the test images are presented in chapter 3.3.

3.1 Hardware

Laura

During the implementation phase, the application was run on two computers, which are described in the following two sections. Both computers needed to be able to deal with the software components described in section 3.2. An extract from your data sheet is shown in table 1 respectively table 2.

3.2 Software

Laura

In order to develop the *Interactive Lighting Detector Qt* was used (compare section 3.2.1). To take advantage of already existing functionalities the *OpenCV*-library, which is described in section 3.2.2, was taken advantage of.

3.2.1 QT

Laura

The *QT Creator* was invented by *The Qt Company*. It is an integrated software development environment in the programming language C++. More functionality can be added by using the Qt project's library, which is called *Qt*. As a cross-platform tool, the *QT Creator* can be used on all common operating systems [8].
Besides extensive database functions and XML-support the software can build graphic user interfaces (GUI).
For this project the algorithm was transcribed in source code using the *Qt Creator* and the GUI was designed in the *Qt Designer* [7].

NAME?	Description
Processor	??
RAM	??
Graphic Card	??
Operating System	??

Table 1: Extract from the Data Sheet of the NAME?

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Acer Aspire 5820TG	Description
Processor	Intel Core i3 CPU @ 2.40 GHz
RAM	4 GB
Graphic Card 1	AMD Mobilty Radeon HD 5000 Series
Graphic Card 2	Intel(R) HD Graphics
Operating System	Windows 10 Education 64 bit

Table 2: Extract from the Data Sheet of the Acer Aspire 5820TG Notebook.

3.2.2 OpenCV

Laura

The *Open Source Computer Vision* (OpenCV) is an open source library for image- and video processing, which is among others available in the programming language *C++*. It has been introduced ten years ago and is developed by various programmers since then. This library offers the most common algorithms, as well as current developments in image processing [1].
On the case of the implementation of the *Light Detector* the library was mainly used for the detecting of the contours (compare section 4.2) and solving the minimization problem (compare section 4.4) introduced by Johnson and Farid [3].

3.3 Testimages

Laura

Due to the assumption that the objects shown on the test images described in section 3.3.1 have a too complicated shape, a second batch of images was made (compare section 3.3.2). Images of both batches were used to test the functionality of the the algorithms used for the lighting detection. All images have in common that besides the actual object they show a sundial to simplify the determination of the light direction for the user.

3.3.1 First Batch

Laura

Four examples of the first batch of test images are shown on figure 1. Next to the mandatory sundial there are different objects depicted, like a helmet, a handbag, a bucket or a hot-water bottle. Those objects differ in their surface texture, as well as their size. They are shot from different angles to produce different light directions. it is necessary that the objects are not trimmed at the boarders of the image, because the algorithm requires a full contour of the selected object.

Figure 1: Examples of the Test Images of the first Batch.

3.3.2 Second Batch

Laura

In contrast to the first batch, the test images described in this section show easier objects with a round surface. As depicted in figure 2 all images show the madatory sundial and one or two table tennis balls in yellow and pink, which have a matt texture. For the actual algorithm of the *Light Detector* only one of this balls is taken into consideration (compare section 4). Properties like size of the object, the camera angle and the lighting direction differs in each image.

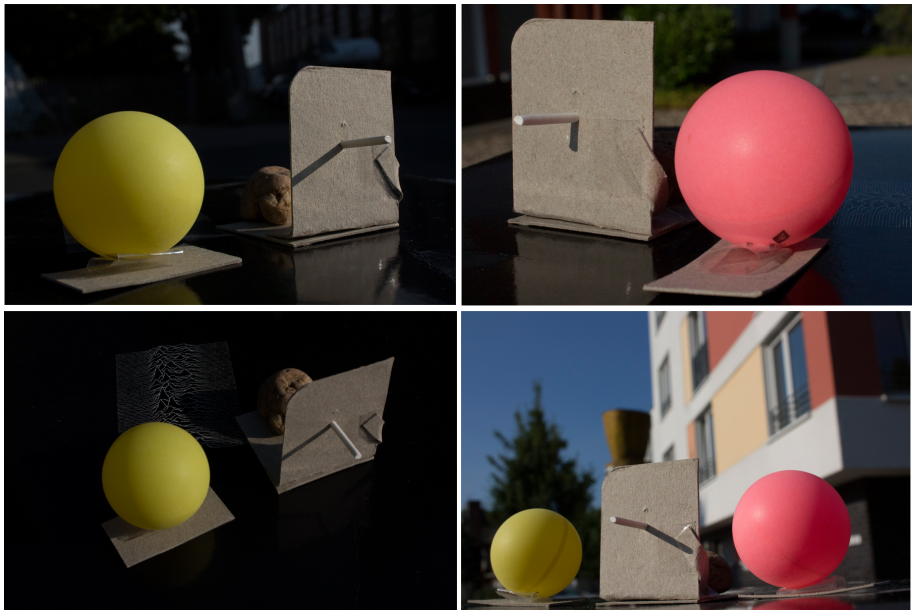

Figure 2: Examples of the Test Images of the second Batch.

4 System

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4.1 Lighting Model

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4.2 Contours

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4.2.1 Find Contours

Vera

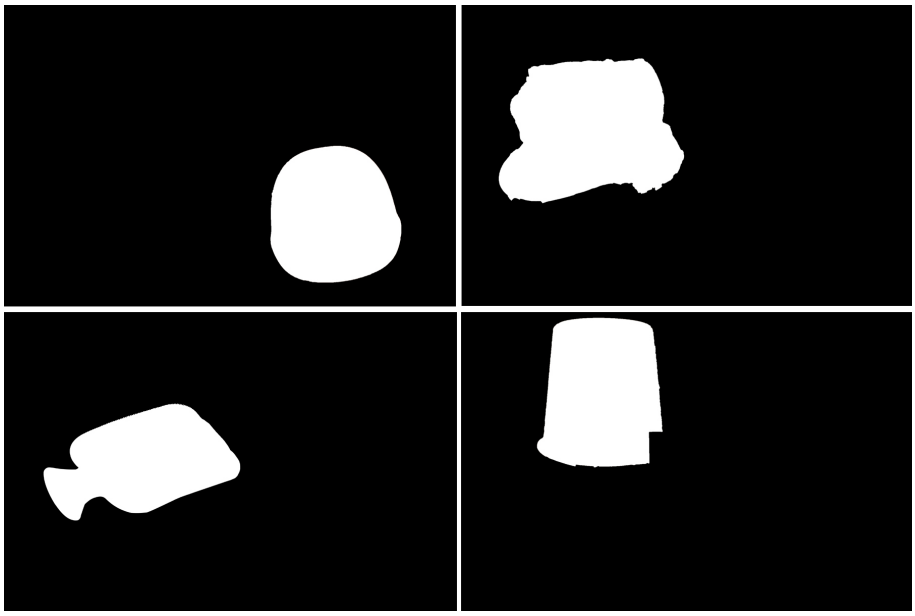

Figure 3: Bildunterschrift.

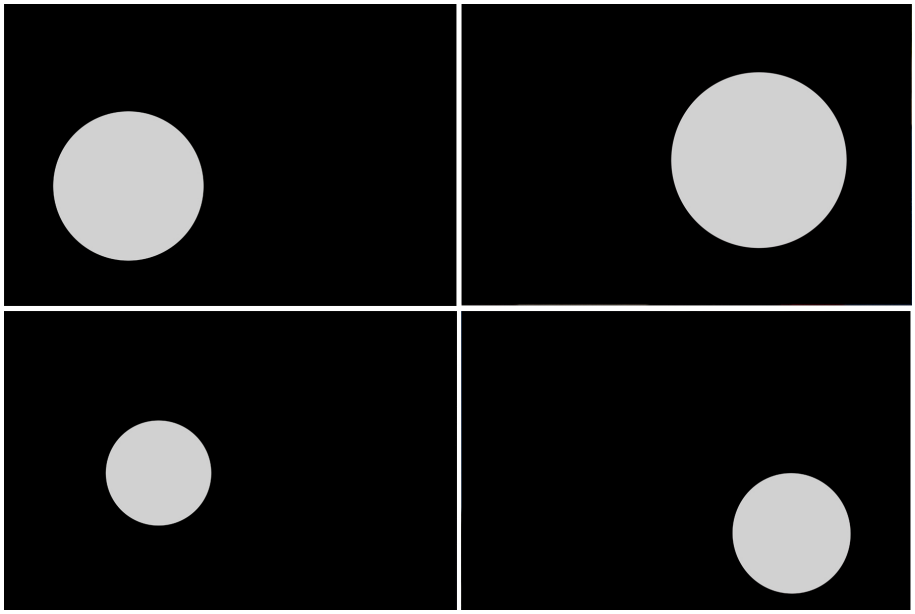

Figure 4: Bildunterschrift.

4.3 Subcontours

Vera

4.4 Different Approaches

Laura

4.4.1 1. Approach: One Lightvector

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4.4.2 2. Approach: Averaging Lightvectors

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4.4.3 3. Approach: Lightvector with highest Intensity

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5 Evaluation

Vera und Laura: Stichpunkte

Vera: Ausformulierung

6 Project Management

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6.1 Project Definition

Laura

6.2 Project Planning

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6.3 Project Execution

Laura

6.4 Project Completion

Laura

7 Conclusion

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