Camera Alignment

Degree programme: BSc in Micro- and Medical Technology | Specialisation: Optics and Photonics
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The triangulation technology is a type of distance measurement. This technology will enable the alignment of a camera axis perpendicular to an artwork, that will be used for research and archiving purposes. In the present work, a system will be developed to measure the angle between the camera and the artwork.

Introduction

The BFH-HKB art school in Bern is analyzing historical artwork and needs to photograph the artworks with infrared or ultraviolet cameras for archiving and research. Usually, photos are taken of small parts and then put together to see the full artwork. The quality of this stitching process is determined by the orientation of the camera.
A time-of-flight measuring system was used and did not meet all the requirements, because the sensors are relatively large, which can affect the illumination of the camera as well as they are costly.
In this project the triangulation measuring system will be applied, to measure the angle between the camera and the artwork. A smart algorithm will to be developed to determine the center of gravity values of the laser spot.

Goal

The main goal of the bachelor thesis is the construction of a system, that determines the angle of the object's surface to the camera axis, using a single miniature camera and two or three laser beams. A suitable algorithm will be developed to determine the angle variation according to the measured center of gravity of the laser spot. The coordinates of the laser must be accurately determined for different artwork surfaces, regardless of color or texture.

The final goal of the bachelor's study is to find the best solution with the minimum number of sensors and a single small camera to enable the alignment of the camera to the artwork.

Concept

Different algorithms have been tested to find the effect of a varying angle of the artwork, in different directions, on the value of the center of gravity of the laser spot.
2D- application with three or two lasers and a small camera are used to detect the variation of the angle of the artwork in two axes. A prototype of the sensor was designed and manufactured in 3D printing technology.

Results

The developed algorithms were tested in one axis for small angles and showed a linear behavior to the laser spots' center of gravity. In the present geometrical setup, the standard deviation in spot coordinates was smaller than 1 pixel corresponding to 1 degree of angle variation. The model was expanded to enable the measurements in all directions.

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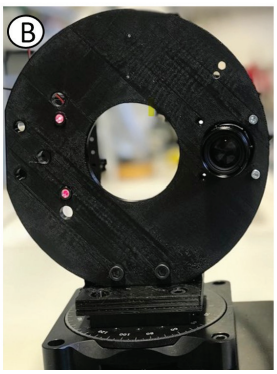

A)Historical image, B)Prototype of the system, C)Small camera, and D)Stepper motor to rotate the image