European Scholar Journal (ESJ)
Available Online at: https://www.scholarzest.com
Vol. 3 No.11, November 2022
ISSN: 2660-5562

CREATING A LASER PHOTOGRAMMETRIC SCANNER WITH A GEOMETRIC LAYOUT

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Article history:

Received: 1st September 2022
Accepted: 1st October 2022
Published: 4th November 2022

Abstract:

In The article presents the development, implementation and evaluation of a low-cost 3D scanner for small objects, which also uses geometric bindings to improve its accuracy and reliability. The scanner described here combines stereoscopic vision techniques with laser triangulation scanner techniques.

Keywords: Tested Procedures With Homologous Points

Two network cameras (simple webcams), automatically calibrated in advance, observe the manual laser level trace on the surface of the scanned object. The visualized laser line allows you to automatically solve the problem of matching between pictograms and, finally, calculate the coordinates of 3D points by applying simple parallax equations to epipolar images [2]. This resolution is improved by adding additional geometric bindings. The system is automatically calibrated based on the beam method (evaluation of the internal orientation of two machines and their correct relative orientation scale) using stereoscopic images of the 2D chessboard control field. For the purposes of this study, an algorithm was developed for determining the coordinate system of the field and collecting its points when automatically evaluating the initial values of parameters [4]. Thus, pairs of images obtained during scanning can now be epi-polarly reassembled (by eliminating errors modeled during calibration, only the laser trace is shown on the epi-polarized images used, since the background is removed from the original images, while to mitigate noise effects smoothing filters are applied. Therefore, the search for point connections is limited to homologous epipolar lines [6]. Homologous points are considered to be intersections of epi polar lines with laser lines, i.e. maxima of image intensity on each epi polar line. Out of all the peak detection procedures tested, the Gaussian curve fit to the tone profile was finally selected. The final peak position is obtained by simultaneously fitting three Gaussian curves, where additional curves are interpolated in two diagonal directions through an initial estimate of the peak position. The peak position should be on the super pole line, but the wider neighborhood of the estimate should also be taken into account to reduce the impact of noise. Uncertainty in determining the position of a point on the surface is a criterion for excluding points during the scanning process. Initial assessment three-dimensional ones 3D coordinates of points from the parallax equations (solution without extra dimensions) are improved by introducing additional geometric constraints: • All points in space reconstructed by each pair of images are track visible as points belonging to the laser plane placing an object at a node formed by two planes (pre-scanned) allows you to introduce an additional congruence constraint for reconstructed points belonging to these planes. Finally, neighboring points must not be more than one boundary away from each other (the anti-aliasing element of the reconstructed surface). In to the article the impact of these obligations is studied and their rigor or flexibility is considered [1]. The general solution is that the coordinates of the full scan points and all unknown level coefficients are evaluated simultaneously using a single iterative correction. The introduction of geometric constraints improves the solution by offering an excess of observations, thereby increasing its reliability, and also allowing you to solve the problem of multiple maxima due to masking or reflections. Withthe generated point cloud can be supplemented with color values from background images, which are extracted from the data set using a temporary method. Interval [3]. Because many scans are required to create a complete 3D model of an object from different positions, separate point clouds must be combined into a single cloud, for example, using well-known algorithms such as ICP. Full automation of the process assumes that the necessary initial approximation of the transformation parameters for ICP should also be evaluated automatically. In this case, it is based on the images themselves, if the object has a minimal texture that allows you to detect points of interest with a sufficient number and appropriate distribution. The SIFT and RANSAC algorithms are used to determine homologous points (based on an epipolar matrix) in image pairs consisting of images obtained from different (neighboring) sources. positions scans for which 3D points in clouds are interpolated from each scan location. Thus, 2D-two-dimensional homologies are reduced to homologies in 3D-three-dimensional space, so now it is possible to automatically transform a rigid body between two overlapping clouds [5]. The final step is to smooth out the generated point cloud. You need to evaluate several different aliasing algorithms applied to combined or individual point clouds. Smoothing is chosen taking into account the fact that the surface is approached locally using elementary mathematical surfaces, with the possibility of introducing an anisotropic weight distribution to take into account the local surface relief. The accuracy of a typical scanner circuit is 0.2 mm, which is estimated both theoretically and experimentally. The accuracy of a typical scanner layout is about 0.2 mm, which is estimated both theoretically and experimentally. Objects of a certain size should be scanned for practical evaluation of accuracy, and the scanner should give satisfactory results on both expensive and inexpensive commercial scanners. For a practical assessment of accuracy, you should scan objects of a certain size, as well as check the scanner on expensive and inexpensive commercial scanners that give satisfactory results [6]. Accuracy should be checked for objects that need to be put into practice, as well as for scanning services and low-cost commercial scanners that have been tested and produced satisfactory results.

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