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| * **Contents -**  1. **Introduction** 2. **Requirement** 3. **Evaluation dataset** 4. **Algorithm evaluation method of camera calibration** 5. **Conclusion**   **Appendix A Height estimation results**   |  |  |  | | --- | --- | --- | | **Author** | Name: Dr. Shengzhe Li  Affliction: Visionin Inc. | Date:  Signature: | | **Advisor** | Name: Dr. Hakil Kim  Affliction: Inha University | Date:  Signature: | | **Approver** | Name:  Affliction: | Date:  Signature: | | **Approver** | Name:  Affliction: | Date:  Signature: | | **Approver** | Name:  Affliction: | Date:  Signature: |  1. **Introduction**    1. Coverage   This document describes the dataset and the method used for evaluating the performance of the simplified camera calibration algorithm[[1]](#footnote-1) in a video surveillance system.   1. **Requirement**    1. Height Estimation Accuracy   The minimum performance requirement for the camera calibration is **above 90%** accuracy.  In a video surveillance system, the camera calibration is used for estimating the height of walking human, therefore, the accuracy in this scenario can be defined as  *Accuracy = 1 – (Estimated height – Ruler height) / Ruler height,*  where the estimated height is the height estimated by the camera calibration parameters and the head and the foot points in an image, and ruler height is the height measured by a ruler. In order to purely evaluate the error caused by the camera calibration, the location of the head and the foot points is manually annotated.   1. **Collection of dataset**    1. Collection of video dataset 2. The experimenter shall collect a video dataset consisted of M subjects and N cameras. 3. The number of video should be equal to M \* N, which should be greater than 10 \* 10 for a meaningful statistics. 4. Cameras at the test site should be installed at the indoor as well as at the outside of building. 5. The resolution for each video should be recorded.    1. Ground truth generation       1. Height measurement by ruler   The height of each subject should be measured with shoes before recording the video.   * + 1. Head and foot points localization by HeightMaker tool  1. HeightMaker.exe (located at ccvs\tool\HeightMaker\) tool is used for manually marking head and foot points in image 2. Edit start.bat file and change the video file path and output head and foot points file 3. Run start.bat 4. Press <Space> when human appeared 5. Drag mouse from head point to foot point 6. Enter the height in the console      1. Press <S> when finished marking 2. Press <A> and <D> to move frame backward and forward 3. Repeat step D to step H to mark 10 to 20 points 4. Press <V> to view current marking 5. Press <F> to save the points data to a file      1. **Algorithm evaluation method of camera calibration**    1. Camera calibration 2. Open CalibrateFromFile.m      1. Edit video width and height (line 4 and 5) 2. Edit the path (line 8) to the points data obtained by 3.2.2 3. Edit camera and subject (line 10 and 11) 4. Edit distortion parameter kd1 (usually 0~0.8) 5. Run the script 6. Check the undistorted image and mean and standard deviation of the error 7. If distortion is still exist then repeat from step E 8. Repeat step B to step H for each camera      * 1. Evaluation of camera calibration  1. Open LOA\_Human.m      1. Edit the path to the points data obtained by 3.2.2 2. Edit camera and subject information (line 7, 9 and 11) 3. Edit video width and height (line 13) 4. Run the script 5. Figure 1 will show the error distribution      1. Figure 2 will show the error by subject      1. Accuracy will be displayed in the command window      1. **Conclusion**   According to the above method, the evaluation result shows that the height estimation accuracy is 99.2% in the dataset, which achieved the performance requirement as specified. |

**Appendix A Height estimation results**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Subject ID | Ruler | Cam01 | Cam02 | Cam03 | Cam04 | Cam05 | Cam08 | Cam10 | Cam11 | Cam12 |
| 1 | 174.5 | 174.4(2.8) | 174.4(2.2) | 174.4(1.8) | 174.4(1.5) | 174.4(4.3) | 174.4(2.1) | 174.4(0.8) | 172.4(2.0) | 174.4(0.8) |
| 2 | 176.5 | 177.5(2.5) | 178.5(1.5) | 179.9(1.4) | 176.5(1.5) | 176.9(2.2) | 177.0(2.0) | 176.4(0.6) | 173.5(0.7) | 176.6(0.8) |
| 3 | 169.5 | 169.6(1.5) | 169.3(2.3) | 171.4(1.8) | 173.7(2.0) | 171.1(1.8) | 170.7(1.7) | 168.9(1.7) | 170.2(2.0) | 171.1(0.6) |
| 4 | 184.5 | 184.4(1.8) | 185.3(2.3) | 186.0(1.5) | 183.6(1.3) | 184.3(5.9) | 182.8(1.1) | 182.3(2.5) | 180.5(1.2) | 181.1(1.1) |
| 5 | 170.5 | 165.8(2.1) | 170.7(1.1) | 169.7(2.6) | 169.0(1.9) | 168.2(1.5) | 167.5(1.2) | 167.5(2.2) | 168.5(1.8) | 170.3(0.6) |
| 6 | 179.5 | 179.0(1.8) | 180.9(1.8) | 180.3(1.5) | 180.3(2.4) | 179.1(2.9) | 179.9(1.3) | 177.1(3.1) | 176.6(1.3) | 177.8(0.3) |
| 8 | 170.5 | 173.1(1.1) | 173.5(1.0) | 172.6(1.9) | 173.5(3.1) | 171.7(2.0) | 170.8(1.1) | 170.5(1.7) | 170.6(2.5) | 171.9(1.3) |
| 9 | 173.5 | 174.6(1.0) | 174.4(1.1) | 174.7(1.3) | 176.8(1.7) | 176.2(4.0) | 174.7(1.0) | 172.4(1.9) | 172.5(1.5) | 173.4(2.3) |
| 10 | 176.5 | 178.5(1.7) | 176.2(1.8) | 177.8(1.2) | 178.1(1.5) | 174.8(3.5) | 176.9(1.8) | 175.6(0.7) | 174.1(1.7) | 175.0(0.6) |
| 11 | 174 | 170.9(3.0) | 173.1(1.5) | 174.5(2.1) | 176.0(2.3) | 175.7(2.3) | 173.2(2.5) | 171.9(2.3) | 171.0(2.6) | 173.5(1.5) |
| 12 | 173 | 171.2(1.6) | 171.7(4.4) | 172.8(1.8) | 172.9(2.8) | 168.1(3.8) | 171.6(1.3) | 172.2(1.1) | 170.5(0.7) | 165.0(1.8) |

(\*) indicates the standard deviation of errors

1. Li, S., et al. (2015). "A simplified nonlinear regression method for human height estimation in video surveillance." EURASIP Journal on Image and Video Processing **2015**(1): 1-9. [↑](#footnote-ref-1)