A Method for Removing Shadows from Photos Taken with a Drone and Stitching the Photos Together

ID: 30067

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Personal Profile

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Graduated from Changzhou Technician College in Jiangsu Province, majoring in computer science and technology,2017.

Currently studying at Tokai University, majoring in Image processing and Artificial Intelligence.

Introduction

- Viticulture in Japan is practiced by cultivating grapevines along trellises above the vines.

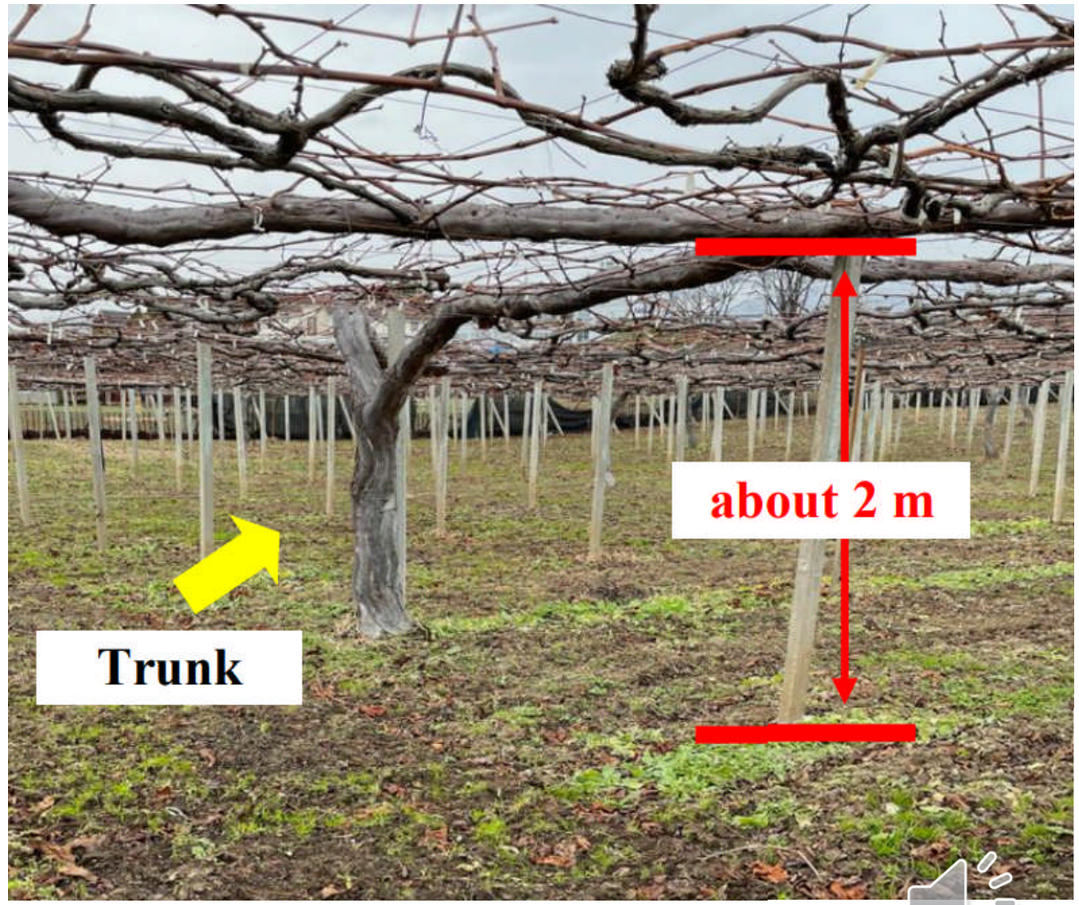

Figure1. Photograph of a grapevine in a vineyard in Japan.

1. Nirasaki-shi, Yamanashi, CUPOD FARM [Online]. Available from: https://www.cupidfarm.co.jp/ [accessed: 2023-03-12]

Introduction

- Figures 2 and 3 show photographs of a grapevine taken from a height of approximately 10 m above the vines in a vineyard.
- The lower half of Figure 2 and the upper half of Figure 3 show the same area.
- The gray-white lines that are connected to a cordon are referred to as arms, and the brown line is also a branch.
- The black lines on the ground are the shadows cast by the vine.

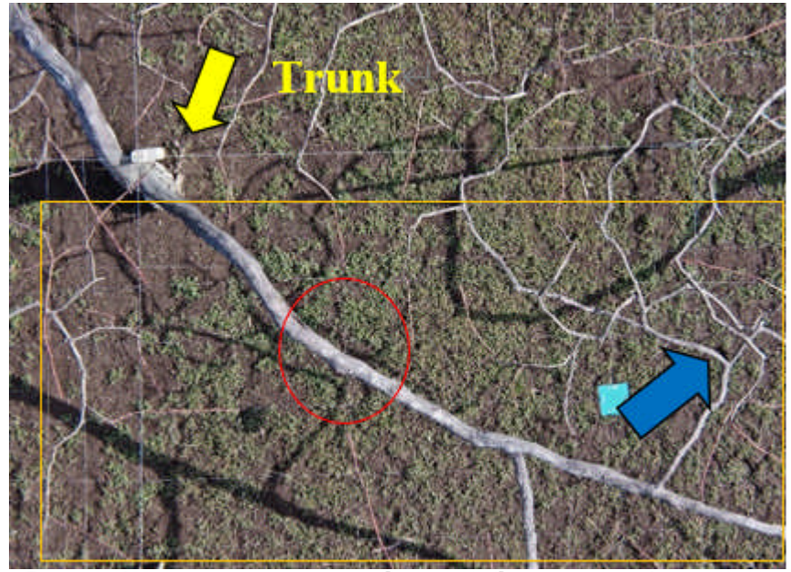

Figure 2 .Aerial photograph of part of a grapevine to show the distribution of cordons and their shadows.

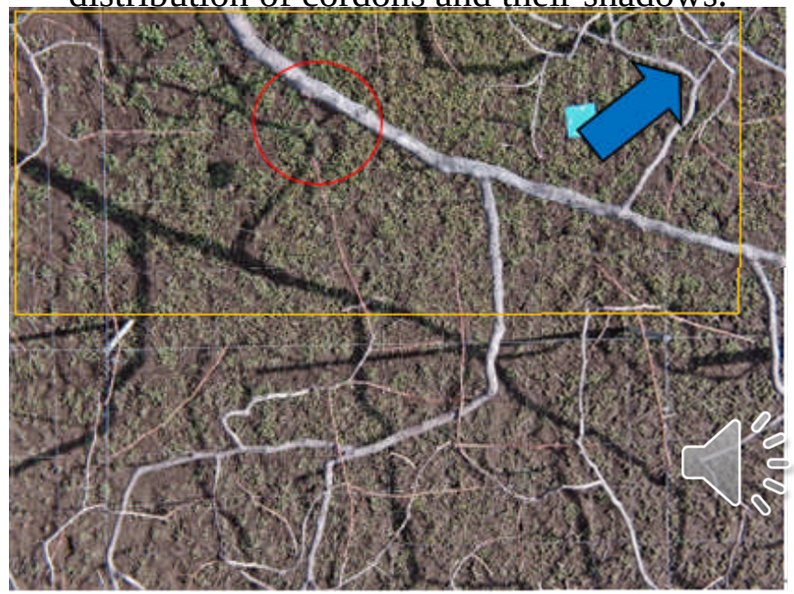

Figure 3.As in Figure 2, except that the image was taken so that the cente of the images is offset by approximately 2 m.

Difficulties In Combining Images

- Images that were combined using photographs taken from slightly different locations showed that cordons in the image appeared cut off or disjointed.

- By the red box in two images resulted in the cordons and other features appearing disjointed.

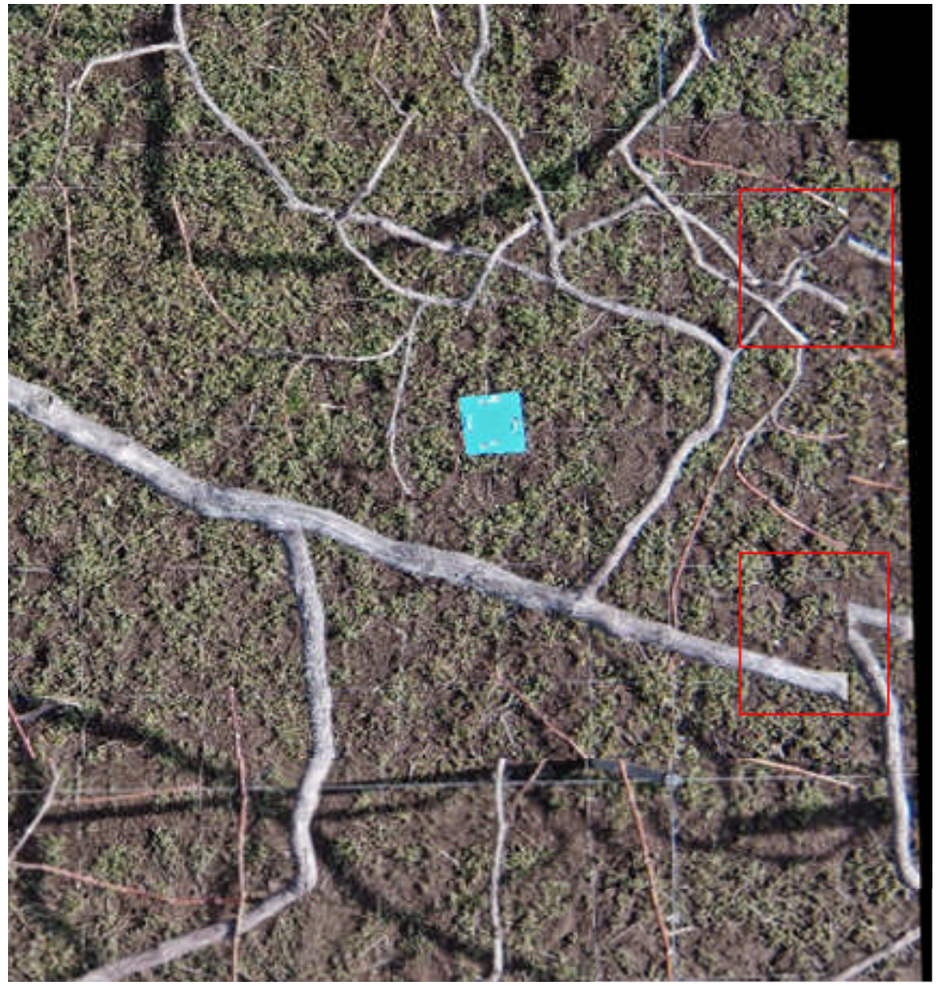

Figure 4. Image showing the photographs shown in Figures 1 and 2 stitched together using a traditional method.

D. G. Lowe, "Object recognition from local scale-invariant features," Proceedings of the Seventh IEEE International Conference on Computer Vision, Kerkyra, Greece, 1999, pp. 1150-1157 vol.2, doi: 10.1109/ICCV.1999.790410

Difficulties In Combining Images

- The circles in Figure 5 indicate SIFT key points and descriptors.
- Corrections need to be made to negate the effect of shadows when combining images of cordons.
- Conventional methods are thus not suitable for analyzing “floating” cordons.

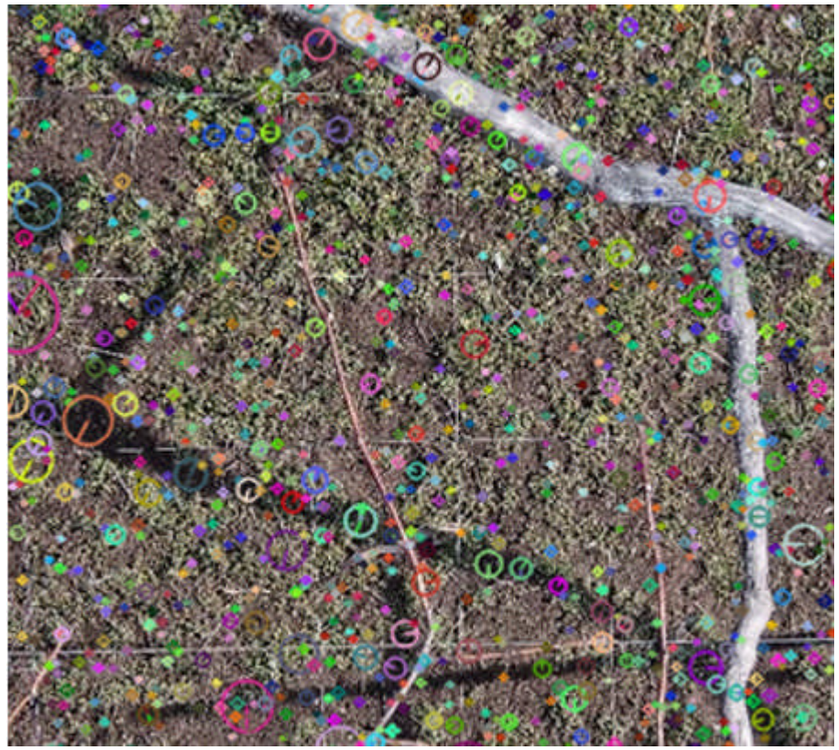

Figure 5. Transformed image showing key points and descripto

Proposed Method

- we developed a method that ignores the effect of cordon shadows and stitches the photos so that only the cordons overlap each other.

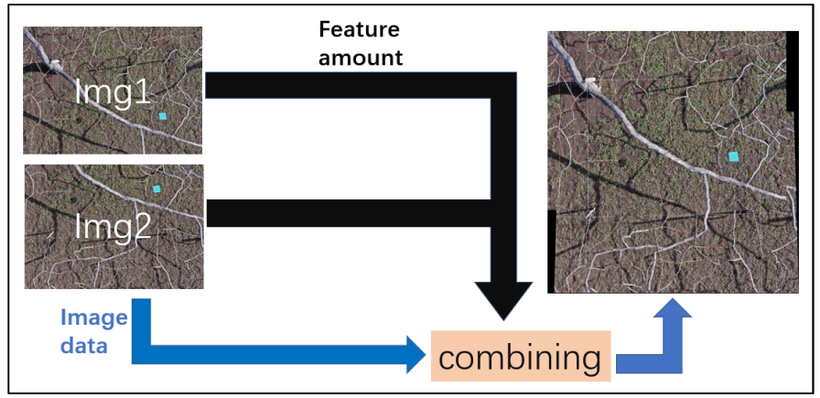

Figure 6. Conventional method for stitching images.

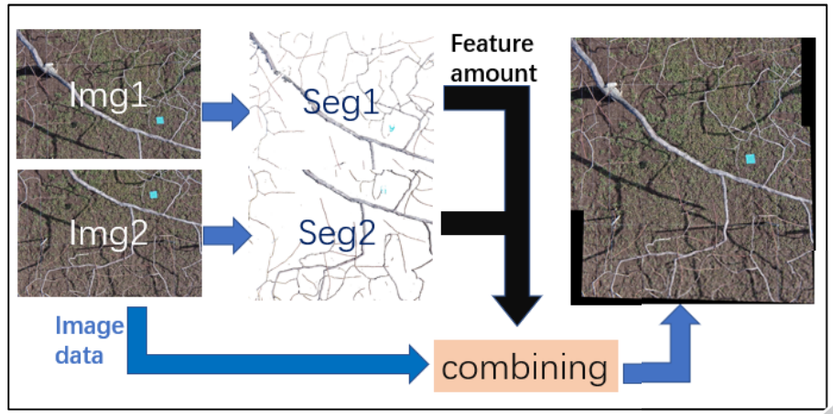

Figure 7. Proposed method for stitching images.

SYSTEM DEVELOPMENT

This alignment procedure can be divided into three steps.

- ①Remove non-vine elements from aerial photos and create images that only show the silhouettes of cordons.
- ②Extract feature points from the silhouettes.
- ③Apply projective transformation to aerial photos based on the extracted feature points and stitch them together.

Step①

- To remove the non-vine elements, we performed semantic segmentation using SegNet , trained the network with 4000 images of cordons and segmented them with a network trained using 100,000 iterations.

Figure 8. Results of image segmentation

Badrinarayanan, V., Kendall, A., Cipolla, R., “SegNet:A Deep Convolutional Encoder-Decoder Architecture for Image Segmentation.” IEEE Trans. Pattern Anal. Mach. Intell. Vol 39, No.12, pp.2481–2495, Dec.2017

Step②

- Feature points and descriptors were extracted from the silhouette images using the SIFT algorithm.

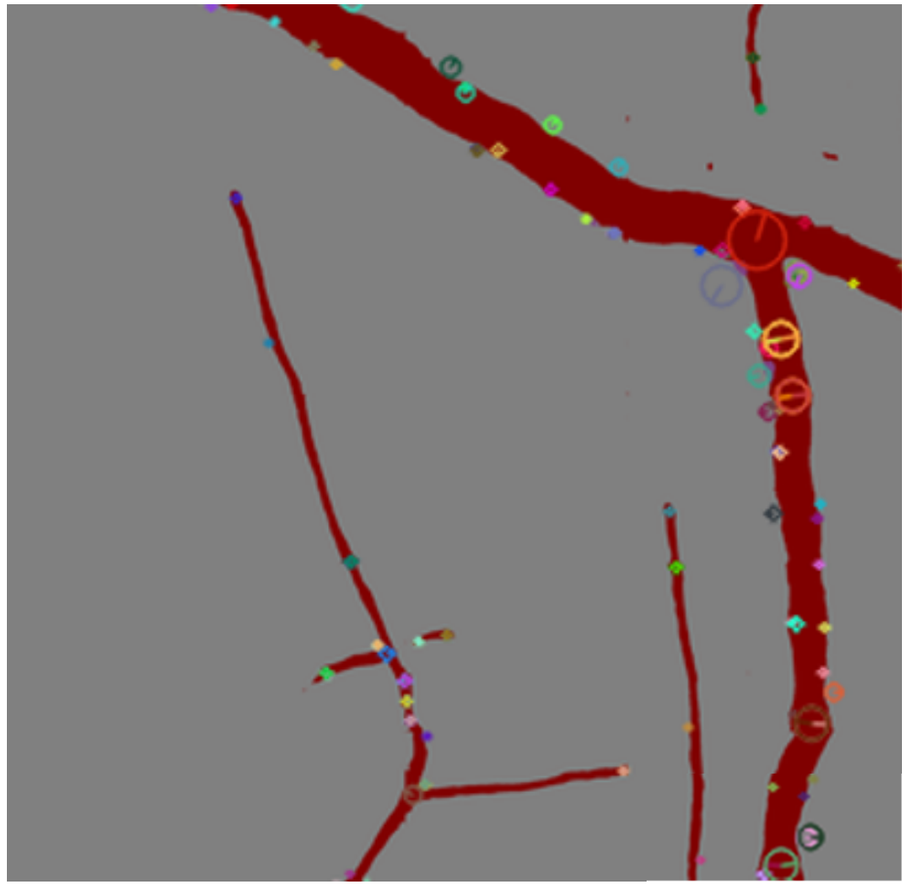

Figure 8 . Results of image segmentation

Step③

- We employed the projection transformation function in the OpenCV library and stitched the images together based on the extent of matching among feature points.

- Figure 9 shown in Figures 1 and 2 stitched together using the proposed method.

Figure 9. Image produced using the photographs shown in Figures 1 and 2 stitched together using the proposed method.

Experiments And Considerations

Figure 9 shows one of the experimental results. And the region enclosed in Figure 4 appears to be fully connected.

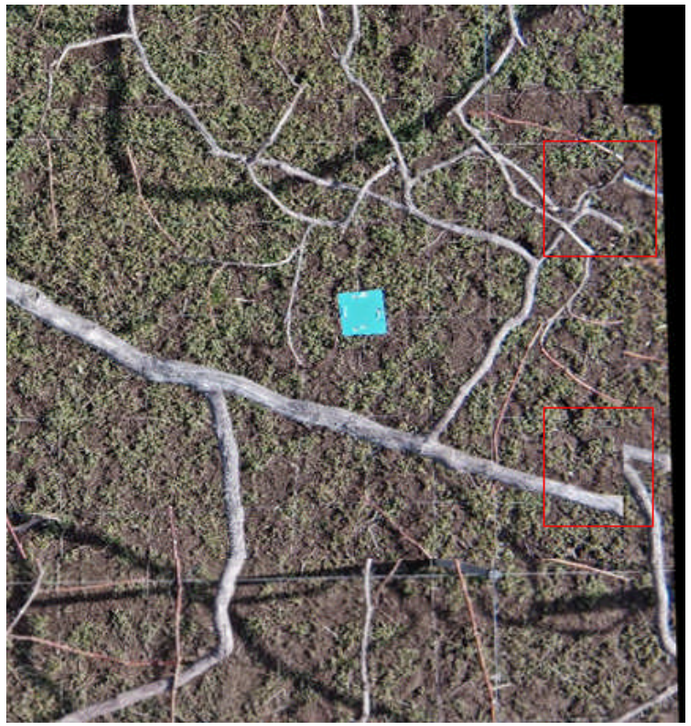

Figure 4. Image showing the photographs shown in Figures 1 and 2 stitched together using a traditional method.

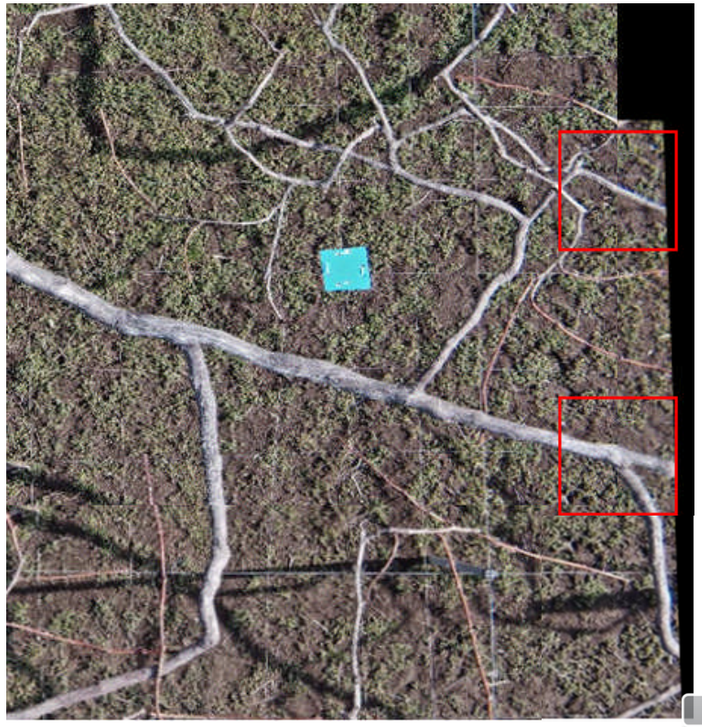

Figure 9. Image produced using the photographs shown in Figures 1 and 2 stitched together using the proposed method.

Experiments And Considerations

- Table I shows the measurement results.
- Compared with the conventional method, the proposed method improved the synthetic precision.
- The method developed for recognizing cordons from aerial images and extracting feature points based on shared features was considered to be effective for connecting cordons seamlessly.

Disjointed distance	Traditional method	Proposed method
Nothing	7	59
One cordon	17	1
Two cordons	16	0
Three cordons	10	0
More	10	0

CONCLUSION

The aim of this research was to accurately overlap cordons at the edges of aerial images being stitched. The findings showed that, compared with previous methods, the proposed method has a higher rate of synthetic precision for the stitching of cordons at the edges of aerial images.

In the future, we would like to stitch all of the aerial photographs so that the cordons overlap.

Thank you for listening!