A New Storage Approach on the Original Cadastral Maps by Multi-View Image Processing Technology

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Abstract

Traditional, the hardcopy of cadastral map is an important historical evidence for the land parcels information in the Land Office. However, the paper is not easy to save and the size of the scanner is not large enough for digital storage either. In this study, multi-view image processing technology is applied to create a true ortho-photo of cadastral map for solving the storage problem.

This study is based on the image of equal ratio for the self-painted land resurveying. And then the true ortho-photo is produced by the various number of photos using multi-view image processing. Results show that the obtained photos have the broken image phenomena when the number of images is less than 15. Comparison of the sampling distance and actual length for more than 15 images, the results show that all the distance error in mm below. To shoot 15 images produced by the true ortho-photo as the basis, the real hardcopy of land resurveying with different scales and not marked distance is implemented. Results indicate that whole distance of errors are smaller than mm. Finally, the all distance errors are less than mm for repetitive experiments with a scalar and labeled length of cadastral map.

The above results show that land resurveying image using multi-view image processing techniques can provide the storage approach with simple, fast, high precision, low cost, and no size constraint.

Introduction

Before the numerical surveying, the cadastral map is also called the resurveying map, is based on the analogous scale of the land clumps of the lines drawn on the drawings.

So far, the local government has accumulated a large number of resurveying map.

These resurveying map are important historical data that records the information of the land and must be kept properly.

There are a lot of difficulties for fully resurveying map of digital storage, including: different periods of different sizes of drawings, no suitable scanning equipment and in accordance with the provisions cannot carry out scanning and so on.

The true ortho image of resurveying map with the same scale can be obtained using the camera to take pictures with multi-view image processing technology in this study.

This approach provides a fast, accurate and low-cost digitizing map of the resurveying map, to solve the problem of preservation of the map.

Experiment Setup

Consider a variety of hardcopy drawing sizes, first design based on 80 lattice, height of 50cm platform, as shown in Figure 1. Each grid size can be placed in the camera.For the production of better image matching results, the image scale constraints are applied in the true ortho image processing process.At the same time on the platform to a fixed distance labeled code, as shown in Figure 2.

The OLYMPUS PEN mini is used to take pictures and the set parameters shown in Table 1.

The commercial software, Photoscan, which is based on the multi-view image principle to make true shot images.

Table1 Camera setting parameters

Pixel	1310Million
Focus range	25mm
Metering mode	Digital ESP metering
Iso	640
Aperture	8
Shutter speed	1/60 秒

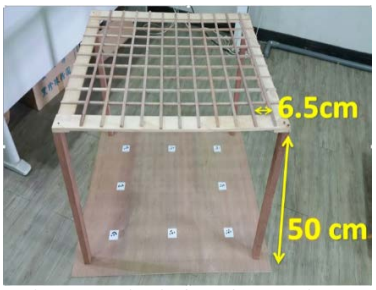

Figure1 Made platform for experiment

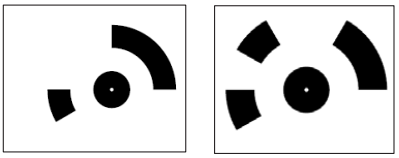

Figure2 Two image matching figure

Five different scale cadastral map are studied in experimental verification, as shown in Figure 3-7, and a building drawing with the scale of 1/200 and annotative length as shown in Figure 8.

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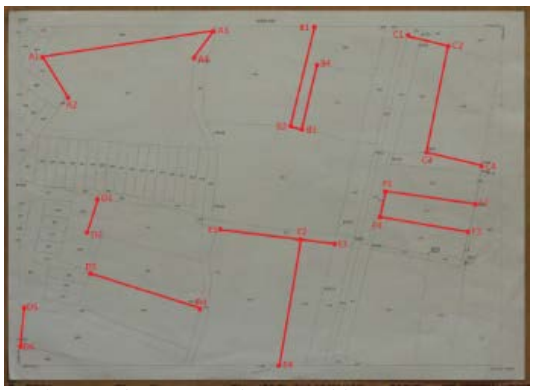

Figure 3 1/500 resurveying map with measured length

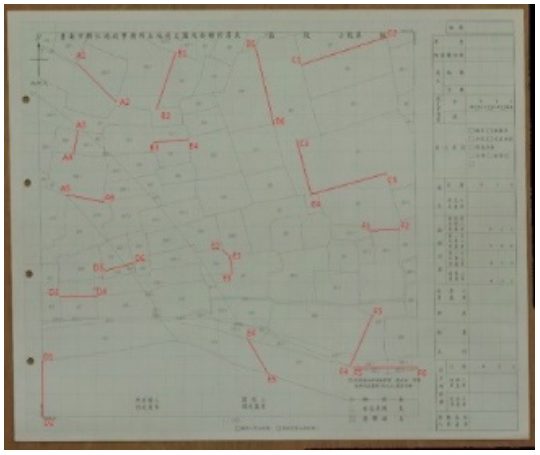

Figure 4 1/200 resuveying map with measured length

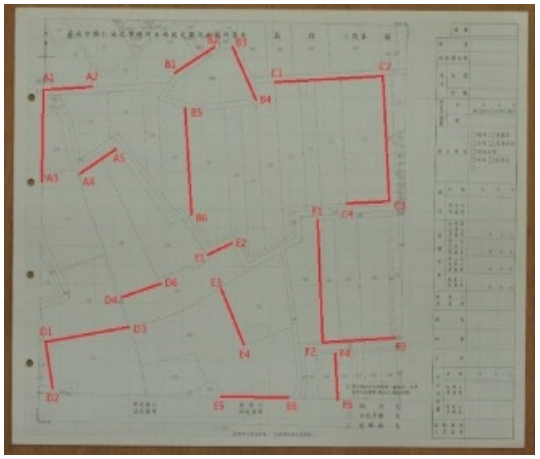

Figure 5 1/1000 resurveying map with measured length

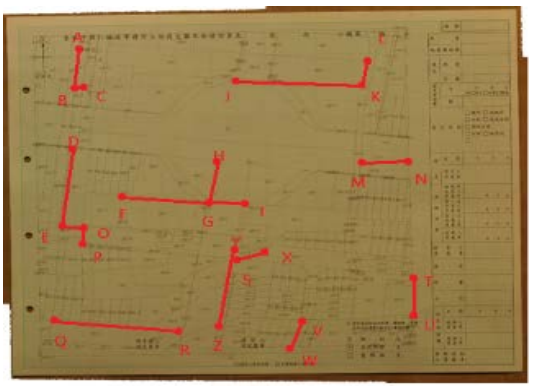

Figure 6 1/600 resuveying map with measured length

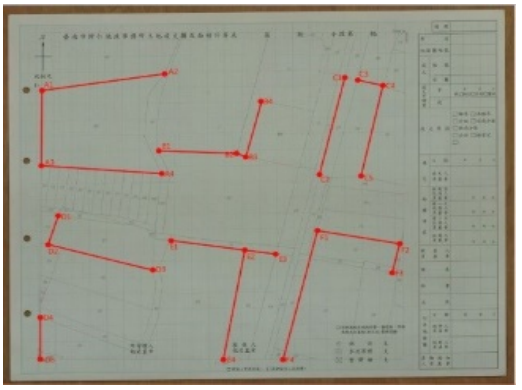

Figure 7 1/500 resuveying map with measured length

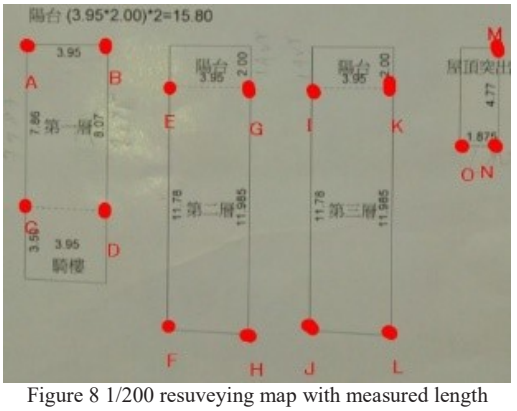

Figure 8 1/200 resuveying map with measured length

Procedure and results

1. Determine the minimum number of photos for producing true ortho images

Using the above design of the camera platform, 6 maps were shot 80 photos and then, take 80,30,20,15 and 12 photos for true ortho image production. Except 12 photos due to lack of overlap caused by true ortho image wtih a broken figure, and the rest can produce a complete real shot image. Where the image processing time of 15 photos is minimal for about 10 minutes. Figure 3-8 is the resulted true ortho images of the

resurveying map.

2. Verify the accuracy of the true ortho image

In order to verify the accuracy of the true ortho image, the random sampling edge is evenly distributed on the six cadastral maps, based on the 15 photos producing true ortho image. Length measurement using AutoCAD MAP software, the length of each side are measured 10 times the average, and then the average and the actual length of comparison. The results of the comparison of each case are shown in Table 2-7.

Table 2-6 are listed the comparison between 18 cases of length of five resurveying map. There are difference of 0.0mm with 83 segments, accounting for 92.2%; difference of 0.1mm with 6 segments, accounting for 6.7%; difference of 0.2mm with 1 segment, accounting for 1.1%. Table 7 is a comparison of the length of the building plane with the true ortho image, a total comparison of 9 segments. There are difference of 0.0mm with 7 segments, difference of 0.1mm with 2 segments. The field errors of each case are in accordance with the error specification error under the scale.

Table 2 Comparison results of 1/500 scale image (mm)

Point	Actual length	Average value	Difference	Field error
A1~A2	39.0	39.1	0.1	5cm
A1~A3	140.0	140.0	0.0	0
A3~A4	25.5	25.5	0.0	0
B1~B2	82.5	82.5	0.0	0
B2~B3	9.0	9.0	0.0	0
B3~B4	54.5	54.5	0.0	0
C1~C2	34.5	34.5	0.0	0
C2~C3	88.0	88.0	0.0	0
C3~C4	46.0	46.0	0.0	0
D1~D2	28.0	28.0	0.0	0
D3~D4	94.5	94.5	0.0	0
D5~D6	31.0	31.0	0.0	0
E1~E2	66.0	66.0	0.0	0
E2~E3	28.0	28.0	0.0	0
E2~E4	103.5	103.5	0.0	0
F1~F2	74.5	74.5	0.0	0
F1~F4	21.5	21.5	0.0	0
F3~F4	74.5	74.4	0.1	5cm

Table 3 Comparison results of 1/200 scale image (mm)

Point	Actual length	Average value	Difference	Field error
A1~A2	44.0	44.0	0.0	0
A3~A4	19.5	19.5	0.0	0
A5~A6	31.5	31.5	0.0	0
B1~B2	48.5	48.5	0.0	0
B3~B4	27.5	27.5	0.0	0
B5~B6	62.5	62.5	0.0	0
C1~C2	76.5	76.5	0.0	0
C3~C4	44.5	44.5	0.0	0
C4~C5	66.0	66.1	0.1	12cm
D1~D2	45.0	44.9	0.1	12cm
D3~D4	30.5	30.5	0.0	0
D5~D6	19.0	19.0	0.0	0
E1~E2	8.0	8.0	0.0	0
E1~E3	14.0	14.1	0.1	12cm
E4~E5	32.5	32.5	0.0	0
F1~F2	24.0	24.1	0.1	12cm
F3~F4	45.0	45.0	0.0	0
F5~F6	54.5	54.5	0.0	0

Table 4 Comparison results of 1/1000 scale image (mm)

Point	Actual length	Average value	Difference	Field error
A1~A2	41.0	41.0	0.0	0
A1~A3	73.5	73.5	0.0	0
A4~A5	38.0	38.0	0.0	0
B1~B2	41.0	41.0	0.0	0
B3~B4	45.0	45.0	0.0	0
B5~B6	84.0	84.0	0.0	0
C1~C2	92.0	92.0	0.0	0
C2~C3	10.0	10.0	0.0	0
C3~C4	36.0	36.0	0.0	0
D1~D2	35.5	35.5	0.0	0
D1~D3	71.0	71.0	0.0	0
D4~D5	35.0	35.0	0.0	0
E1~E2	22.9	22.9	0.0	0
E3~E4	50.0	50.0	0.0	0
E5~E6	56.5	56.5	0.0	0
F1~F2	97.0	97.0	0.0	0
F2~F3	62.0	62.0	0.0	0
F4~F5	35.8	35.8	0.0	0

Table 5 Comparison results of 1/600 scale image (mm)

Point	Actual length	Average value	Difference	Field error
A~B	36.5	36.5	0.0	0
B~C	6.5	6.5	0.0	0
D~E	74.0	73.8	0.2	12cm
F~G	75.0	75.0	0.0	0
G~H	38.4	38.4	0.0	0
G~I	29.4	29.4	0.0	0
J~K	108.5	108.5	0.0	0
K~L	24.0	24.0	0.0	0
M~N	41.0	41.0	0.0	0
E~O	18.5	18.5	0.0	0
O~P	16.5	16.5	0.0	0
Q~R	109.5	109.5	0.0	0
S~X	26.0	26.0	0.0	0
X~Y	25.5	25.5	0.0	0
Y~Z	73.5	73.5	0.0	0
S~T	153.0	153.0	0.0	0
T~U	37.0	37.0	0.0	0
V~W	28.0	28.0	0.0	0

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Table 6 Comparison results of 1/500 scale image (mm)

Point	Actual length	Average value	Difference	Field error
A1~A2	109.0	109.0	0.0	0
A1~A3	71.0	71.0	0.0	0
A3~A4	106.5	106.5	0.0	0
B1~B2	68.5	68.5	0.0	0
B2~B3	9.0	9.0	0.0	0
B3~B4	54.0	54.0	0.0	0
C1~C2	93.0	93.0	0.0	0
C3~C4	23.5	23.5	0.0	0
C4~C5	88.0	88.0	0.0	0
D1~D2	28.0	28.0	0.0	0
D2~D3	95.5	95.5	0.0	0
D4~D5	40.0	40.0	0.0	0
E1~E2	66.1	66.1	0.0	0
E2~E3	27.5	27.5	0.0	0
E2~E4	105.0	105.0	0.0	0
F1~F2	74.5	74.5	0.0	0
F2~F3	28.5	28.5	0.0	0
F1~F4	125.5	125.5	0.0	0

Table 7 Comparison results of 1/200 scale image (mm)

Point	Actual length	Average value	Difference	Field error
A~C	39.3	39.3	0.0	0
B~D	40.3	40.3	0.0	0
E~F	58.9	58.9	0.0	0
G~H	59.9	59.9	0.0	0
I~J	58.9	58.9	0.0	0
I~K	19.7	19.7	0.0	0
K~L	59.9	59.9	0.0	0
M~N	23.8	23.9	0.1	2cm
N~O	9.3	9.4	0.1	2cm

Conclusion

Experimental results show that the true ortho image produced by multi-view image processing technology has been able to meet the relevant accuracy requirements. Using the self-designed platform to take pictures of six pictures with serveral size of different scale maps, it can really storage the hardcopy of the resurveying map.

Due to multi-view video technology produced by the true ortho image results and the precision and height of the camera has a high correlation. To the current design the 50cm height of platform, the case need to shoot 15 photos in order to produce a complete true ortho image. Furthermore, it should be redesigned to be able to adjust the height and positioning of the camera with the platform, in response to more different sizes and accuracy requirements of the map at any time to adjust the best camera time and image processing time.

Reference

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