بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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MONA MAGHRABY

Assessment of Terrestrial Laser Scanner in Civil Engineering Application (Facade Documentation with Single Image)

A Thesis
Submitted to the Public Works Department
Faculty of Engineering
Ain Shams University
For the Fulfillment of the Requirements of M. Sc. Degree
In Civil Engineering (Surveying)

Prepared by

Mohammed Abbas Mohammed Abbas

B.Sc. in Civil Engineering, June 2015
Higher institute of Engineering, Shrouk Academy

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Cairo, 2020

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DEDICATION

This work took years from my life. I wish to dedicate it to who suffered to educate, prepare and help me to be as I am,

TO MY MOTHER AND THE SOUL OF MY FATHER

Also, I wish to dedicate my thesis

to my brother

for their encouragement, prayers and the help to complete this work.

I would like to dedicate my thesis to the man who raised me who was a father,brother and everthing in my life for his soul

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Statement

This dissertation is submitted to Ain Shams University, Faculty of Engineering, public works department for the degree of M. Sc. in Civil Engineering (Surveying).

The work included in this thesis was carried out by the author in the department of Public Works, Faculty of Engineering, Ain Shams University, from 2016 to 2020.

No part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

Survey of architectural facades, to obtain elevation drawings, is an essential, especially in case of maintenance, restoration,...etc. Laser Scanning is able to record thousands of points per second, recording target position (X, Y, Z), intensity, and color (RGB) with a reasonable accuracy. It also collects 3D data of any large-scale, complex, irregular, standard or non-standard objects, and then quickly rebuilds 3D model and cartography.

Sometimes there are shadow areas that not be observed by Laser Scanners. The reasons for these shadow areas are different planes of a façade, the existence of an obstacle between the façade and the laser scanner and a personal mistake while choosing the scan width on the laser scanner. Even more, disappeared data are not appeared due to the existing of an obstacle between the laser scanner and the required facade. Therefore, the rapid progress of the obtained image size captured by digital cameras opens new areas for the captured images to be used in photogrammetry.

One of these new areas is the use of a single digital image for surveying and recording of architectural facades. The ease use of the digital photogrammetry may overcome the previously mentioned problems with a minimum and faster fieldwork. A permanent record is taken of very large number of target points. Photo coordinates measurements with a high degree of accuracy can be obtained, due to the large scale of the taken photographs.

So, the main objective of the current research is completing the TLS scanned area, using single images. This happened through simplifying the Direct Linear Transformation (DLT) equations for facades documentation. Then, developing a computer algorithm using least squares adjustment method for transforming the image coordinates to the ground coordinates. After this, studying the practical visibility, applicability, and accuracy of merging the data comes from a single digital image captured by a digital camera with the TLS in surveying architectural facades.

To achieve the above-mentioned goal, three field experiments are made with different conditions. The first field experiment was made to evaluate the Laser Scanner accuracy compared with the Total Station non-prism data. The second field experiment was made to evaluate the single digital image captured by digital camera compared with the Total Station non-prism data. The third field experiment was made to evaluate the single digital image captured by digital camera compared with the laser scanner data to fill the laser scanner shadow areas.

After this, three case studies were made to investigate the practical visibility and applicability of using single digital image to complete the laser scanner data.

The obtained results proved the success of the supposed technique and its related computer algorithm in the survey and the record of the vertical architectural facades. In the first experiment the RMS of discrepancies are 9mm in X direction, 25mm in Y direction, 9mm in Z direction and 28mm in position. In the second experiment the accuracy ranges from 7 mm to 19 mm with image resolution equal or lower than 9.7