Assessment of Different Surveying Techniques for Heritage Documentation

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

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Cairo, 2019

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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 FATHER AND MY MOTHER

Also, I wish to dedicate my thesis

to my sisters and the beautiful of my life

for their encouragement and help to complete this work.

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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 2018.

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

Documentation of heritage buildings has become a key issue for most countries to preserve their old treasure buildings and being left and kept in their original shapes. Hence, it is a must and in a deep need for any country to protect these buildings through different surveying techniques for the production of a corresponding accurate three dimensional models of these buildings to ease the retrieval of their originality after being exposed to any sort of damage. So, archeological documentation of the facilities is of great importance in the process of restoration. At the beginning, photogrammetry was widely used in the field of restoration and documentation, in spite of its multiple and complicated sequential steps for data production. Over the past few years, the number of historical monuments and archaeological items recorded using innovative 3D scanning techniques has increased significantly.

In this study, the terrestrial laser scanner technique was used for heritage site documentation in two different facades in Egypt: Faculty of Engineering, Ain Shams University and El-Zaafrana palace. Actually and to reach reasonable positional accuracy, all related criteria have been investigated. Since these criteria are dependent on each other, a perfect combination must be implemented and nearly maintained when using laser scanners.

The most efficient practical condition must combine resolution, acquisition and processing time, scanned distance and field of view. The Trimble TX5 has an optimal resolution as (1/4) within a preferable range of scanned distance lying between 14.0 m and 20.0 m away from the target. The scanned distance should preserve a vertical angle in the composed

field of view up to 40°. Also, it is more convenient to avoid quality greater than 4x. All these criteria is combined with suitable time in both data acquisition and processing, in order to minimize the effort and cost. These considerations have a predicted positional accuracy as 2.0 cm, with an effective 3D model.

Moreover and in order to have a complete comprehensive evaluation of the used terrestrial laser scanner, an obtained 3D model of another facade was examined. In this context, this 3D model revealed a good matching of all existing details and decorations. Also, the dimensions and orientations of some features were extracted with high accuracy.

Keywords: Terresterial laser scanner, TLs, Point Cloud, 3D Registration, Georeferencing, Heritage Buildings, Assessment.

Acknowledgement

First, and foremost, thanks are due to Allah,

the most beneficent and merciful of all.

In the beginning, I would like to extend my sincere thanks and respect to **Prof. Dr Mohamed El-Tokhey** who helped and supported me to finish this work, he was always available whenever I needed any advice, and for always giving me the positive energy to achieve what I want.

Having a supervisor like **Prof. Dr Ibrahim Shaker** was one of the best experiences I had. His care, patience, support and encouragement, are most appreciated. Despite his busy program, his door was always open for my questions, problems, and guidance to recover when my steps faltered.

My profound appreciation is due to **Prof. Dr Ayman Ragab**, for instructive guidance and reading of the early draft of the manuscript. I am deeply grateful to him for the long discussions that helped me in sorting out the technical details of my work.

My sincere thanks also go to **Dr Yasser Mogahed,** for his that greatly enriched this work a lot for his continuous encouragement and advice throughout my studies and his technical support and care and the great lessons which I learned from him.

I am greatly indebted to my colleagues: **Eng. M. Ramadan, Eng. M. Shebl, Eng. T. Waleed, Eng. A. Abdelmaabod, Eng. E. Ashour and Mr. Sayed El-Shiemy** for their appreciated help and support in the field works of my research.

I also wish to thank all staff members and colleagues of the public works department, Ain Shams University, for their kind help, moral support and nice feelings.

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