DEVELOPMENT OF A MOBILE ROBOT SPATIAL DATA ACQUISITION SYSTEM

By

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MASTER OF SCIENCE
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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

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SPECIAL DEDICATION

All praise and glory are expressed to almighty Lord for His blessings and strengthen me to complete this thesis.

Utmost gratitude to my parents, Ooi Ah Seng and Kee Gaik Tiang

for their patience, faithfully and undying love for my success.

Beloved brother and sisters, Ming Kee, Wei Ping, Ming Vee

for inspiring in me all the time

and

Finally, to my dearest Lover, Foo Yen See, who is always on my side,

never ending support, patience and encouragement.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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July 2006

Chairman : Professor Shattri Mansor, PhD

Faculty : Engineering

This research focused on developing a spatial data acquisition system using mobile robot technology and close-range photogrammetry technique without ground control points (G.C.Ps) on the images. Image capturing of object features and their planimetry positioning were acquired by a mobile robot and applied to create 3D plans which include contour plan, slope plan and location plan. PhotoModeler, Matlab programming and ArcView GIS software were used in the processing to create the detail plans. Additionally, the accuracy of mobile robot system was thoroughly tested and validated in real-world condition. Results showed that the coordinate accuracies computed from robot-based images in non-G.C.Ps were achieved within a range between 1.8 cm and 99 cm.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PEMBANGUNAN SISTEM MENPEROLEHI DATA SPATIAL DENGAN MENGGUNAKAN ROBOT MUDAH ALIH

Oleh

OOI WEI HAN

Julai 2006

Pengerusi : Profesor Shattri Mansor, PhD

Fakulti : Kejuruteraan

Tesis ini berfokus dalam membangunkan satu sistem memperolehi spatial data dengan melibatkan teknologi robot dan teknik fotogrammetri dengan tanpa berpandukan kepada sebarang titik kawalan dalam imej. Robot digunakan untuk pengumpulan spatial data serta menentukan kedudukan lokasi objek dalam imej yang diperolehi. Koordinat-koordinat objek ini digunakan untuk memplotkan pelan-pelan 3-D termasuk pelan kontor, pelan cerun serta pelan lokasi. Semua proses dan hasil menggunakan perisian-perisian seperti PhotoModeler, Matlab dan ArcView. Ujian-ujian ketepatan terhadap sistem ini telah dilaksanakan sepenuhnya dalam situasi yang sebenar. Keputusan yang diperolehi menunjukkan nilai ketepatan bagi koordinat-koordinat objek imej robot berada dalam lingkungan 1.8 cm dan 99 cm.

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Lastly, the author would like to express his sincere appreciation to his family for their undying love, patience, encouragement and continues supports during the course of study.

I certify that an Examination Committee has met on 3rd July 2006 to conduct the final examination of Ooi Wei Han on his Master of Science thesis entitled "Development of a Mobile Robot Spatial Data Acquisition System" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declared that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

OOI WEI HAN

Date:

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LIST OF ABBREVIATIONS

3D	3 Dimensional
AS	Anti Spoofing
CRP	Close Range Photogrammetry
DoD	Department of Defense
ESRI	Environmental System Research Institute
GPS	Global Positioning System
GIS	Geographical Information System
GCP	Ground Control Point
INS	Inertial Navigation System
IMU	Inertial Measurement Unit
LSE	Least Square Adjustment
MRT	Malayan Revised Triangulation System
MMS	Mobile Mapping System
PM	PhotoModeler software
PPS	Precise Positioning Services
PRN	Pseudo Random Noise
RTK	Real Time Kinematic
RSO	Rectified Skew Orthomorphic System
SA	Selective Availability
SPS	Standard Positioning Services
WGS84	World Geodetic System 1984