UNIVERSITI TEKNOLOGI MARA

WATER QUALITY MONITORING USING LOW-COST DIGITAL CAMERA

ERNIEZA SUHANA BINTI MOKHTAR

Thesis submitted in fulfillment of the requirements
for the degree of
Master of Science

Faculty of Architecture, Planning & Surveying

May 2008

Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicates or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and be subjected to the disciplinary rules and Universiti Teknologi MARA.

Name of Candidate:		Ernieza Suhana Binti Mokhtar
Candidate's ID No.:		2005221800
Programme	:	AP780
Faculty	:	Faculty of Architecture, Planning and Surveying
Thesis Title	:	Water Quality Monitoring Using Low-Cost Digital Camera

Signature of Candidate .....

Date 30/5/2008

ABSTRACT

Water quality describes the physical, chemical and biological characteristic of water that relates to human and nature life. Water quality parameters consist of Total Suspended Solids (TSS), turbidity, Secchi Disk Depth (SDD), temperature and colour. Example of factors affecting the quality of water bodies (i.e. lakes and reservoirs) are urban runoff, solid waste and soil erosion. Several methods i.e. conventional method, satellite remote sensing method, and digital camera method can be used to determine water quality parameters. Conventional method involves collecting water sample and laboratory analysis. This method is time consuming and not efficient to represent water quality of large area. Satellite remote sensing techniques using various sensors i.e. Landsat, Moderate Resolution Imaging Spectroradiometer (MODIS), IKONOS and Tiungsat-1 can be used to assess several water quality parameters (i.e. TSS, turbidity, chlorophyll and SDD) on large area coverage. Although this method can be used to monitor water quality of large area, image acquisition and data processing are costly and time consuming. A number of studies have utilized digital cameras to determine the water quality parameters; the results are still not conclusive. The aim of this study is to access the potential use of low-cost digital cameras in water quality assessment. Based on this aim, the objectives are i) to determine the relationship between digital number (DN) and TSS concentrations using different digital cameras; ii) to determine turbidity concentrations based on the calculated TSS values and iii) to compare TSS and turbidity concentration based on different models, different digital cameras and different dates of study area. The study areas for this research are two lakes located at Section 7 and Section 14 (Taman Tasik Shah Alam). This study only concentrates on two water quality parameters (i.e. TSS and turbidity). Two digital cameras (i.e. Olympus FE-100 and I-iC2070) each costing less than RM1000 were used to capture image of the water surface. The methodology adopted for this research involve i) collecting water samples, ii) capturing digital images of water surface, iii) data analysis (including regression analysis and generating water quality maps of the study area). Water samples collected in these two lakes were processed in the laboratory to determine the TSS and turbidity concentrations. Digital images captured on three different dates i.e. 1st and 15th September 2006 and 23rd November 2006 were used to determine the regression models (or relationship between DN and water quality concentration). Images acquired on the 8th and 15th February 2007 were used to generate TSS and turbidity maps of Tasik Shah Alam. Kriging interpolation module in the ArcGIS 9.0 software is used to generate the water quality maps of the study area. Linear regression algorithm is used to determine the relationship between DN and TSS concentrations and relationship among water quality parameters (i.e. TSS and turbidity). The relationship between TSS and turbidity concentration is R^2=0.73. Six multiple regression models have been developed by the author to relate the DN of the two digital cameras and TSS concentrations. The highest correlation (R^2=0.96, RMSE=±7.94 Model 3) using multiple regression model is obtained using Olympus FE-100 digital camera. Results obtained from the Olympus FE-100 digital camera differ slightly with obtained from I-iC2070 digital camera. The correlation between different models ranged from 0.94 to 0.96 for Olympus FE-100 digital camera and 0.93 to 0.95 for I-iC2070 digital camera. Findings from this research have shown that images acquired from low-cost digital cameras can be used to assess water quality.

ACKNOWLEDGEMENTS

All praise due to Allah, the Most Gracious and the Most Merciful for giving me good health and strength to complete my research.

The first person I would like to thank is my supervisor, Assoc. Prof. Dr. Wan Mohd Naim Wan Mohd, Dean of the Faculty Architecture, Planning and Surveying, Universiti Teknologi MARA for his guidance, understanding and encouraging during this research.

I wish to express my warm and sincere thanks to Assoc. Prof. Dr. Junaidah Ariffin; Deputy Dean (Resources and Students) and Mrs. Nora Sofian; Water Laboratory Technician from Faculty Civil Engineering, Universiti Teknologi MARA, Shah Alam for the permission of using Environmental Laboratory and gave me untiring help during my research.

I am deeply grateful to Mr. Idris and Mr. Saiful from MBSA for their kind assistance to fulfill research requirement. I wish to thank my friends, Siti Yuraida Mohd Yusoff, Azizan Kassim and Shamiruddin Mahammad Azami for helping and encouraging me get through the difficult times during this research.

This research has been supported and funded by Ministry of Science, Technology and Innovation (MOSTI). I thank to MOSTI for their confidence in me. My special gratitude is due to my parents and my fiancee, Mohd Hafiz Ahmad for their understanding and loving support.

TABLE OF CONTENTS