

DEVELOPMENT OF A REMOTELY OPERATED  
UNDERWATER VEHICLE SYSTEM

EZMAHAMRUL AFREEN BIN AWALLUDIN

MASTER OF SCIENCE  
UNIVERSITI MALAYSIA TERENGGANU

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

This thesis is dedicated to my parents especially for my beloved mother Noor Latifah Osman, my father Awaludin Majid, my wife Wan Nurul Jawahir Binti Hj Wan Yusoff and my loving son Muhammad Zamir Danish who have supported me all the way since the beginning of my studies with a great source of motivation and inspiration. Finally, this thesis is dedicated to all those who believe in the richness of learning.

**EZMAHAMRUL AFREEN BIN AWALLUDIN**

"Thank you for everything"

**Thesis Submitted in Fulfilment of the Requirement for the  
Degree of Master of Science in the Faculty of Science and Technology  
Universiti Malaysia Terengganu**

**April 2007**

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu in fulfillment of the requirement for the degree of Master of Science

Development of Remotely Operated Underwater Vehicle System

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This thesis is dedicated to my parents especially for my beloved mother Noor Latipah Osman, my father Awalludin Majid, my wife Wan Nural Jawahir Binti Hj Wan Yussof and my loving son Muhammad Zaim Danish who have supported me all the way since the beginning of my studies with a great source of motivation and inspiration. Finally, this thesis is dedicated to all those who believe in the richness of learning.

Faculty of Science and Technology

This thesis presents the development of a remotely operated underwater vehicle named Universiti Malaysia Terengganu Remotely Operated Underwater Vehicle (UMTROV). The UMTROV is designed for low water environment down to 100 meters depth. The UMTROV is designed for simple control maneuvering with the ability to inspect underwater environment as well as to acquire selected underwater data. UMTROV is propelled by four thrusters making it possible to move in horizontal, vertical and lateral axes. UMTROV uses two computers for remote control operation namely host computer for vehicle control and a single board computer which is attached in the junction box inside the UMTROV for data acquisition and communication purposes. A host computer consists of two notebook computers. The first host computer provides a facility to remotely control the UMTROV by an operator as well as providing the necessary graphical user interface for underwater data display and storage facilities into

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EZMAHAMRUL AFREEN AWALLUDIN

April 2007

Chairperson: Associate Professor Muhammad Suzuri Hitam, Ph.D

Member : Professor Md. Yazid Mohd Saman, Ph.D.  
Associate Professor Khalid Samo, Ph.D.

Faculty : Science and Technology

This thesis presents the development of a remotely operated underwater vehicle named Universiti Malaysia Terengganu Remotely Operated Underwater Vehicle (UMTROV). The UMTROV aims to operate in shallow water environment down to 100 meters depth. The UMTROV is designed for simple control maneuvering with the ability to inspect underwater environment as well as to acquire selected underwater data. UMTROV is propelled by four thrusters making it possible to move in horizontal, vertical and lateral axes. UMTROV uses two computers for remote control operation namely host computer for vehicle control and a single board computer which is attached in the junction box inside the UMTROV for data acquisition and communication purposes. A host computer consists of two notebook computers. The first host computer provides a facility to remotely control the UMTROV by an operator as well as providing the necessary graphical user interface for underwater data display and storage facilities into



database system. This first host computer uses the Windows® XP Professional as an operating system and MATLAB version 6.5 as a programming language. The second notebook computer is used to display captured underwater video, video editing and recording purposes. The other computer is a Single Board Computer (SBC) that provides direct interface to all the thrusters and sensors. In this project, the SBC TS-5400 card is employed and operated under Disk Operating System (DOS) with C programming language.

The UMTROV data acquisition system consists of underwater video inspection system and underwater data acquisition system. Video data is captured by Deep Blue underwater camera and directly sent to host computer using a separate umbilical cable. The Dazzle® software is used to view, store and edit the captured video data. The data acquisition system consists of seven types of sensors namely water level, pH, turbidity, conductivity, dissolved oxygen (DO), temperature and oxidation reduction potential (ORP). The UMTROV has been tested to operate in both the fresh water and ocean environments for its operational capability. The outcome of these tests showed the UMTROV could be successfully used in shallow water environment while capable to acquire and store the predetermined underwater data sampling rate. It is anticipated that further development should be carried out so that this UMTROV could be deployed in deepwater environment.

Abstrak tesis yang dikemukakan kepada senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk Ijazah Sarjana Sains.

Pembangunan Kenderaan Kawalan Jauh Bawah Air

EZMAHAMRUL AFREEN AWALLUDIN

April 2007

Pengerusi : Professor Madya Muhammad Suzuri Hitam, Ph.D

Ahli : Profesor Md. Yazid Mohd Saman, Ph.D.  
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Fakulti : Sains dan Teknologi

Tesis ini menerangkan pembangunan sebuah kenderaan kawalan jauh di dalam air yang dinamakan sebagai Universiti Malaysia Terengganu *Remotely Operated Underwater Vehicle* (UMTROV). UMTROV bertujuan untuk menjalankan operasi di dalam persekitaran air cetek berkedalaman kurang dari 100 meter. UMTROV direka bentuk untuk memudahkan olahgerak kawalan dengan kebolehan memeriksa persekitaran air dan perolehan data terpilih di dalam air. UMTROV ini dilengkapi empat alat penujah membuatnya berupaya bergerak dalam arahan mengufuk, menegak dan sisi. UMTROV menggunakan dua komputer bagi tujuan kawalan jauh iaitu komputer hos untuk kawalan kenderaan dan dilengkapi komputer papan tunggal yang diletakkan di dalam kotak fungsian bertujuan untuk perolehan data dan komunikasi. Komputer hos terdiri daripada dua buah komputer riba. Komputer hos pertama menyediakan kemudahan antaramuka pengguna yang diperlukan untuk pemaparan data bawah air, dan kemudahan penyimpanan data ke sistem



pangkalan data. Komputer riba ini menggunakan sistem pengoperasian Windows<sup>®</sup> XP Profesional dan perisian MATLAB versi 6.5 sebagai bahasa pengaturcaraan. Komputer hos kedua digunakan untuk memaparkan video, penyuntingan video dan pengrekodan video. Komputer lain yang digunakan ialah sebuah komputer papan tunggal (SBC) yang menyediakan antaramuka terus kepada alat penunjuk-penunjuk dan pengesan-pengesan. Bagi projek ini, kad SBC TS-5400 digunakan di bawah sistem pengoperasian cakera (DOS) dengan bahasa pengaturcaraan C.

Sistem perolehan data UMTROV terdiri daripada sistem perakam video dalam air dan sistem perolehan data di dalam air. Data video dirakam oleh kamera dalam air *Deep Blue* dan dihantar terus ke komputer hos menggunakan kabel yang berasingan. Perisian Dazzle<sup>®</sup> boleh digunakan untuk memapar, menyimpan dan menyunting data video yang diperolehi. Sistem perolehan data terdiri daripada tujuh jenis pengesan iaitu pengesan paras air, pengesan pH, pengesan kekeruhan, pengesan konduktiviti, pengesan oksigen terlarut, pengesan suhu dan pengesan potensi pengurangan pengoksidaan. UMTROV telah diuji keupayaannya beroperasi dalam dua keadaan di dalam persekitaran air tawar dan air laut. Hasil kajian yang telah dijalankan didapati UMTROV boleh digunakan dengan jayanya dalam persekitaran air cetek di samping berupaya untuk memperoleh dan menyimpan kadar sampel data di dalam air yang telah dikenalpasti. Dijangkakan pembangunan lanjutan diperlukan untuk memastikan UMTROV boleh dilaksanakan di persekitaran air dalam.