Design and Development of an Underactuacted Autonomous Underwater Vehicle (X4-AUV) with Four-Inputs and Six-States

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Abstract

A lot of knowledge deep down the sea still cannot be unfold by researches today as the human cannot stand the underwater pressure after 500 meter depth in average with scuba-dive tool and less than 6000 meter depth in average by using submarine as it will proportionally increase as the depth is increase. Invention of Remotely Underwater Vehicle (ROV) has been bring up by the researches in order to encounter the human limitation in this issue but still did not produce the end solution as the user which control the vehicle will lost its connection and control of the vehicle after it reach more 6000 meter depth as the effect of the pressure. The idea of Autonomous Underwater Vehicle (AUV) comes next as the demand of underwater system rises. This vehicle capable to navigate in abyssal zone without necessitating a tether that limits the range and maneuverability of the vehicle. In this project, an X4-AUV hardware and software systems is developed. The development of the X4-AUV body is based on ellipsoidal shape where we consider the slenderness ratio in the design of the body. X4-AUV also equipped with four thrusters where the design is based on the quad rotor concept. ARDUINO UNO REV-3 will be act as a controller to control the thrusters (motor). The waterproof temperature sensor will act as location identifier sensor as it will keep transmitting the real time temperature value to the controller while the LCD shield for ARDUINO will display the value of the temperature based on the transmitted value. The user will able to continuously identify the location of X4-AUV by serial communication in ARDUINO software via XBEE wireless communication between ARDUINO located at X4-AUV controller and at control centre PC. The X4-AUV will able to perform its task as it will move underwater according to the set of program language coded in the controller.

Keywords. AUV; Ellipsoid body; Slenderness ratio

1   Introduction

There are almost 71% percent of the earth surface occupied by the ocean which not fully discovered yet because of various problems and limitation like low transparency, human limitation against water pressure and cannot observe the ocean in detail from the surface. In order to encounter this limitation, various of research have been conducted on underwater vehicle like manned submersible, unmanned underwater vehicle which can be divided into two types [1]. Remotely Operated Vehicle (ROV) is one of the type that been applied to the underwater vehicle where is perform best at detailed observation and sampling in small range. Autonomous Underwater Vehicle (AUV) is the second type that does not need human to maneuver it and also not need to be connected to the support vessel is perform best detailed survey on wide area [1]. A lot of study on AUV type have been conducted which will open the door of new era of underwater research and development. Even though the unmanned system(AUV) able to expand the underwater research, but there are some aspect that need to be improved like the body design of the vehicle in order to ensure the vehicle can operate efficiently [2]. In order to make that happen, several study on the shape of aquatic animal like fish, turtle, and eel have been conducted since this creature able to adept the underwater environment like water pressure , drag force, drift force and diving speed [3], [4], [5]. By applying the underwater creature shape to the AUV, this will give the system more capabilities to perform its task underwater.