Indonesian Journal of Electrical Engineering and Computer Science
Vol. 8, No. 2, November 2017, pp. 582 ~ 585
DOI: 10.11591/ijeecs.v8.i2.pp582-585

Remotely Operated Submarine Vehicle Control Using Fuzzy Logic

P. Palanichamy
Department of Mathematics, AMET University, Chennai, India

Abstract

Submerged marine investigation still remains a puzzle. The motivation behind this paper is to address the issues in plan and improvement of submerged vehicles with hindrance shirking and moving help for administrator in marine condition utilizing fluffy rationale controller. A symmetrical, practical and little measured submerged Remotely Operated Vehicle (ROV) with three thrusters is intended for testing control calculation and execution of framework. Kinematics of the ROV is produced relating rate of revolution of thrusters with ROV'S straight and precise increasing speed. A near investigation of the framework's reaction for basic if-else rationale and with fluffy rationale controller for route is made and assessed. A Graphical User Interface (GUI) with live bolster is given to the administrator to more extensive scope of visual perception of submerged condition and navigational guide.

***Keywords**: Fuzzy logic controller; Obstacle avoidance; computer simulation*

1. Introduction

A ROV is a fastened submerged robot which is controlled remotely from a gadget generally put in a watercraft or ship. Tie is a gathering of links that convey electrical power, control signs, video and information motions forward and backward between the administrator and the ROV. Extra hardware like SONAR, magnetometer, a still camera, a controller or cutting arm, water samplers, instruments that measure water lucidity, light entrance and temperature are generally added to grow the vehicle capacities.

The goal of this paper is to plan and build up an ease and upgradable ROV [1] (for achieving confounded errands in future) which conquers navigational confusions. Mechanical outline is made utilizing Solid Works programming as shown in Figure 1.

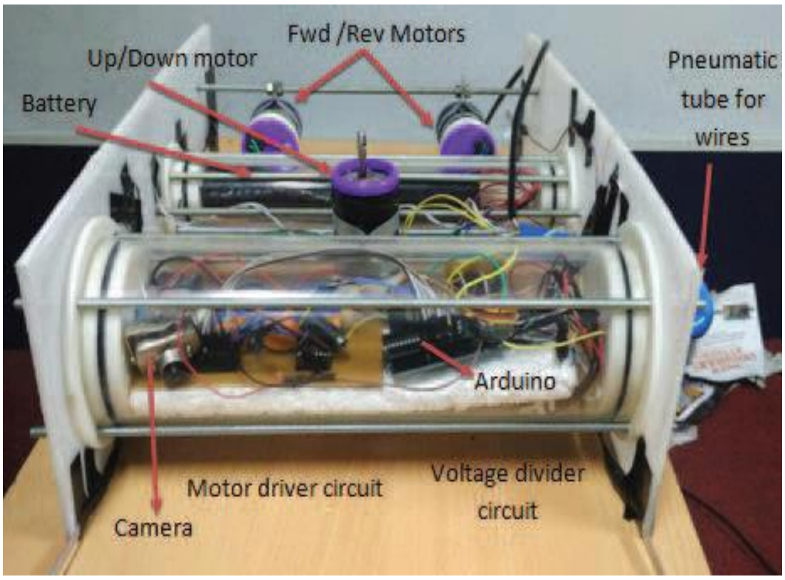

Figure 1. Complete ROV System

Received June 29, 2017; Revised September 5, 2017; Accepted September 23, 2017

UI is outlined utilizing Python and obstruction shirking highlight is joined utilizing Fuzzy rationale. Flex sensors are utilized to detect hindrances ROV's vicinity and interfaced with microcontroller to keep away from obstructions and to accomplish better mobility. An inbuilt power source is used to enable the ROV to come up to the surface in case of tether cut or failure.

2. Mechanical Design

Mechanical structure is the foundation of the ROV [2] and is worked from segments as straightforward as conceivable without trading off any usefulness such that the flow of the vehicle is not influenced. Straightforward acrylic container of 3 mm thickness, 300 mm length, and 100 mm measurement is decided for making frame due to its quality and capacity to repulse water. The round shape takes into account smooth streamlined stream of water [3]. A camera housed inside the straightforward body would give a clearer and smooth picture. Two such tubes with various distances across, one for circuit lodging and other for battery lodging are utilized [4]. End Caps are machined from a thick piece of propylene to fit the acrylic tube firmly and a section is made to settle the O-rings to seal the tube appropriately. In this paper also referred in, a discrete time retrial inventory system with d-map demands [8].

3. Electrical Design

A robust electrical design has been implemented to control the actuator direction by using both GUI and semi-automated control using flex sensors for obstacle avoidance. ATMEGA 328P microcontroller is chosen for interfacing sensors, actuators and serial communication. Three H-Bridge motor driver with ULN2003A current driver IC is used for driving the thruster motors.

4. Fuzzy Logic Controller

Apart from simple if-else algorithm discussed above, a fuzzy logic aided navigation control of underwater ROV is implemented. Operator’s input to the ROV is based on the visual feedback given by the camera attached to the ROV. The fuzzy logic controller acts as brain of the ROV in taking decisions [3, 4]. Fuzzy logic controller reduces the operator fatigue and strain, as obstacle detection and avoidance is taken care of. The Obstacle Avoidance Control (OAC) layer is executed utilizing fluffy rationale. T1, T2 and T3 speak to the pushed of focus, left and right thrusters individually, which are figured from each layer.

The primary goal of this layer is to obtain the obstacle information. The flex measured by the front-left, front-right, back-left and back-right flex sensors are denoted as flex_sensor1, flex_sensor3, flex_sensor2 and flex_sensor4 respectively [5-7]. Corresponding operator input is given through joystick. Input trapezoidal participation work for flex sensors are given as cluster [0 0 140 150], [120 140 255 255] for close and far vicinities (low and high) separately. A review of [8] represents a discrete time retrial inventory system with d-map demands. In review of paper [9] it describes an Evaluation of mechanical properties aluminium metal matrix composite for marine applications. Investigation of Enhanced Oil Recovery (EOR) [10] Surfactants on Clay Mixed Sandstone Reservoirs for Adsorption was studied. Experimental examination of tensile is described and impact behavior of aluminium metal matrix composite for turbocharger. Enrollment work for administrator data sources are given as [0 30 70 80], [60 70 160 170], [140 160 255 255] for low_value, med_value and high_value individually for various bearings.

5. Result

Multiple input - multiple output fuzzy logic controller is implemented for semi-autonomous control of ROV. Comparative study on performance of simple If-Else loop and fuzzy logic controller that provides control signal to thrusters with same sensor input conditions is done. It can be observed from Figure 2 that test run with fuzzy logic control is more convenient for operator to navigate through unstructured environment than simple If-Else logic, due to the reason that If-Else logic uses binary values as sensor inputs whereas fuzzy logic uses range of sensor input values.

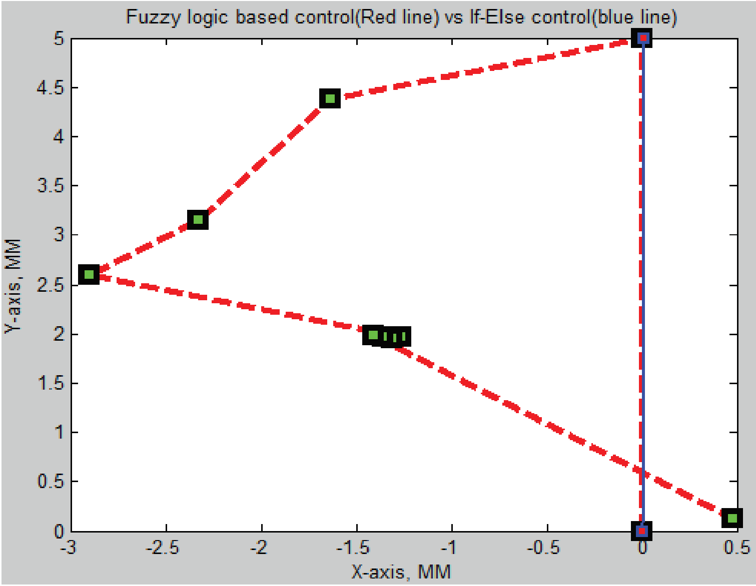

Figure 2. Path Traveled by ROV during Test Run

6. Conclusion

This paper is an endeavor to plan and create financially savvy submerged mechanical framework for actualizing and understanding the working of various control calculations. This submerged test stage is fantastic for showing of ideas and scholastic research. Both navigational control rationale is executed and from the outcomes obviously fluffy rationale controller can build the simplicity of route and operation of ROV through complex condition and consequently customary ability and experience is not required for the administrator. The remote camera gives better perspective of the submerged condition. The safeguard mode is made in order to give the ROV a reinforcement power when there is loss of tie which makes it achieve the surface by obstruction evasion utilizing flex sensors.

References

[1] Tehrani, NH, Heidari, M, Zakeri, Y, Ghaisari, J. *Development, depth control and stability analysis of an underwater Remotely Operated Vehicle (ROV)*. In Control and Automation (ICCA), 2010 8th IEEE International Conference on (2010: 814-819). IEEE.

[2] Marzbanrad, AR, Eghtesad, M, Kamali, R. *A robust adaptive fuzzy sliding mode controller for trajectory tracking of ROVs*. In Decision and Control and European Control Conference (CDC-ECC), 2011 50th IEEE Conference on (2011: 2863-2870). IEEE.

[3] Lin, WP, Chin, CS, Mesbahi, E. Remote robust control and simulation of robot for search and rescue mission in water. In OCEANS 2014-TAIPEI (2014:1-9). *IEEE*.

[4] Johnson, J, Madhumitha, G, Yousuf, N, Harikrishnan, S. *Design, development and fuzzy logic based control of a remotely operated underwater vehicle*. In Robotics and Automation for Humanitarian Applications (RAHA), 2016 International Conference on (2016: 1-6). IEEE.

[5] Healey, AJ, Rock, SM, Cody, S, Miles, D, Brown, JP. 1994 July. Toward an improved understanding of thruster dynamics for underwater vehicles.

[6] Miles, D, Healey, AJ, Cody, S, Rock, SM, Brown, JP. 1994. Toward an Improved Understanding of Thruster Dynamics for Underwater Vehicles.

[7] Mussa, AW, Sandham, WA, Durrani, TS. 1998. Underwater robotics navigation using multi-sensor fusion.
[8] Periyasamy, C. A Discrete Time Retrial Inventory System with D-Map Demands. *International Journal of Pure and Applied Mathematics*, 2015; 98(5): 45-54.