Universidad Continental

FACULTAD DE INGENIERÍA

Escuela Académico Profesional de Ingeniería Mecatrónica

Tesis

Proof of concept of an ROV to measure the contamination level of natural waters in peruvian high andean zones

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Para optar el Título Profesional de
Ingeniero Mecatrónico

Huancayo, 2022

PUBLICACIÓN - GARCIA ROMERO - HUARIPATA LEON

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Proof of Concept of an ROV to Measure the Contamination Level of Natural Waters in Peruvian High Andean Zones

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***Abstract*— Robotic engineering has grown rapidly thanks to the use of underwater robots that began to revolutionize water exploration, providing better information in future research. The objective of the study was to validate the proof of concept of an ROV using a variable control and distribution system. The requirements analysis was developed using a methodology based on the VDI2206 standard. The study detailed the classification of underwater robots according to their autonomy, mission type and propulsion. In addition, it presented the general design showing the structure of the underwater robot, the central processing unit and the subsystems (communication, navigation, safety, propulsion, data acquisition and power supply). Likewise, the specific design presented the 3D modeling and description of the parts in the inventor software. Regarding the control and communication system, the radio frequency circuit was designed and simulated. The results obtained were the validation of the control system and distribution of variables for the proof of concept of an ROV. The main quality of the underwater robot is its stability and hermeticity, since it was designed to withstand a desired immersion process. Other important features are its easy portability, data transfer fluidity and corrosion resistance.**

Keywords—Proof of concept, ROV, natural waters, high Andean zones.

I. INTRODUCTION

Water pollution has become a global problem [1]; analyzing its situation requires taking into account issues related to its distribution and access [2]. Of this 2.5%, 30% is underground, 68% in glaciers and 1.2% on the surface [3]. Polluters do not always suffer the negative effects; on the contrary, producers or consumers are affected by pollution [4]. It is estimated that the situation has worsened for more than 260 million people around the world [5].

The main factors affecting water ecosystems are human activities, mining and smelting constitute the major part of heavy metal pollution [6]. Such events represent a serious threat to the ecological environment [7]. The rate of water pollution can be around 200 Mm3/d [8]. This fact leads to many problems in both plant, animal and human life because these metals are deposited in the soil, thus transported to them by rivers, reducing the growth in plants and causing diseases to living beings [9].

In recent years, robotic engineering is growing rapidly through the use of underwater robots that have begun to revolutionize water exploration [10]. The technology of underwater robot multi-agent system has a wide scope in future water pollution research [11].

Autonomous computing elements can interact with each other, for a more complex type of social activity (cooperation, coordination and negotiation) [12]. Underwater robots must be able to move and maneuver in the water. This is the so-called Unmanned Underwater Vehicle (UUV). Among them, the Remotely Operated Vehicle (ROV), is considered semi-autonomous and requires human intervention for remote operation, they use integrated sensors to collect, store and display data in a computer. Also, within the same class, interventions, in Autonomous Unmanned Vehicles (IAUV), are considered semi-autonomous, as they require the participation of an operator who supervises the missions of the underwater vehicles [13].

Among these robots is a ROV submarine that is used to collect floating garbage, plastic waste spilled from fuel floating in the water, oil present in expanses or difficult to access, such as lakes, canals, industrial facilities with storage capacity, they collect 70 to 80 L of floating waste and more than 30 hydrocarbons in each expedition [14], another robot is the Autonomous Surface Vehicle (ASV) to measure pollution levels in water using sensors and modules placed in fixed positions [15] and there is also an ROV configured with a microcontroller, equipped with a camera able to move detecting obstacles and pollutants in real time [16].

The result of the article aims to analyze the proof of concept of an ROV to measure the degree of contamination of natural waters through the validation of a control system and distribution of variables.

This work is organized as follows: section II presents the materials and methods that are classified in the description of requirements analysis together to the methodology to be used, for the analysis of the proof of concept of an ROV, we will also see the classification of underwater vehicles, general design, specific design, control system and communication, the results are detailed in section III and the conclusions will be in section IV.

II. MATERIALS AND METHODS

The ROV proof of concept methodology is based on the VDI2206 standard used for mechatronic system design

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