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INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)
(Int Peer Reviewed Journal)
Vol. 04, Issue 12, December 2024, pp : 407-412

e-ISSN : 2583-1062
Impact Factor : 7.001

REMOTE CONTROLLED UNDERWATER EXPLORATION DRONE

Ravindra Dinkar Jadhav[1], Parag Gajanan Mane[2], Digvijay Amar Mane[3]

[1,2]Students, Electronics And Tele-communication Engineering, Adarsh Institute Of Technology And Research Centre, Vita, Maharashtra, India.

[3]Head of Department, Electronics And Tele-communication Engineering, Adarsh Institute Of Technology And Research Centre, Vita, Maharashtra, India.

ABSTRACT

The project aims to develop an underwater inspection drone that can navigate easily underwater and allow us to vide live video footage underwater. The drone provides following advantages including: Easy to Navigate Underwater, 360 Degree Direction Control, Live Footage Viewing, Dual Motor Propulsion system, Lightweight and anti-rust design for long term usage. The RC drone uses 2 x motors for propulsion and a separate motor for depth/direction control. Both motors are attached with propellers to achieve this task. This mechanism makes use of a unique rudderless mechanism using motor drives to control 360 degree movement of the drone. This mechanism does not make use of ballast tanks to control buoyancy. The drone consists uses the 2 motors to provide front drive as well as for left right direction control. The 3rd motor is used to control the vertical alignment of the drone. This motor in combination with other 2 motors is used to dive in or bring up the drone. All motors and controller unit is enclosed in a water proof chamber. The drone now uses a camera to capture footages underwater. These footages are transmitted to the floating buoy unit from there user can connect via wifi to check the footages. The system makes use of a raspberry pi controller for footage transfer as well as wifi transmission. Also the buoy unit is used to pullout the drone in case it gets stuck or runs out of battery under water

Key word: Ballast tanks, RC under water, Buoy unit.

1. INTRODUCTION

In the uncharted depths of the underwater world, a new frontier awaits exploration and discovery. The "RC Underwater Exploration Drone" emerges as a technological marvel designed to unlock the mysteries concealed beneath the surface. This remotely controlled drone boasts a comprehensive set of features that make it an indispensable tool for underwater exploration and rescue operations. Equipped with a state-of-theart camera, powerful flashlights, and brushless motors, this underwater drone is armed with the tools needed to navigate and illuminate the unseen realms of the ocean. Its electronic clamp hook adds a versatile dimension, allowing it to interact with its surroundings and perform a variety of tasks. Built for the explicit purpose of underwater exploration, this drone is a silent observer in the depths. It possesses the capability to delve into unknown territories, capturing the mysteries of the underwater world through its built-in camera, delivering live video footage to the surface. Operated remotely, the drone offers a user-friendly interface, allowing operators to navigate and control its movements with precision. This remote control feature ensures that the drone can explore vast underwater expanses without physical limitations. A built-in camera provides a live video feed, enabling realtime monitoring of the underwater environment. This feature is not only essential for exploration but also proves invaluable in search and rescue missions, providing crucial information to operation the surface.To overcome the challenges of low visibility in the depths, the drone is equipped with high-brightness lights. These lights pierce through the darkness, ensuring that the underwater drone can capture clear visuals and illuminate its surroundings for effective exploration. designed to navigate both the depths and the surface, this drone is capable of submerging and resurfacing at will. Its adaptability to different water levels makes it an ideal companion for a range of underwater missions, from scientific research to emergency response. The RC Underwater Exploration Drone is not just a tool for exploration; it's a lifeline in rescue operations. Its ability to reach otherwise inaccessible underwater locations positions it as a critical asset in search and rescue missions, environmental monitoring, and scientific research. .In summary, the RC Underwater Exploration Drone represents a leap forward in underwater technology, offering a versatile and powerful tool for uncovering the mysteries of the deep and contributing to the safety and well-being of those in need. Its integration of advanced features and remote control capabilities marks it as a beacon in the realm of underwater exploration.

2. LITERATURE REVIEW

[1] R. Kawada et.al explain The authors are developing “combined aerial and underwater drones” to address issues such as manpower shortages in inspecting water area infrastructure and monitoring aquaculture farms. This system enables such work without sending out divers or boats. An aerial drone carries an underwater drone to the work area and after it lands on the water, the operator remotely controls the underwater drone while viewing live images and location information from both drones via a mobile network (LTE). Acoustic positioning provides the location information of the underwater drone. SSBL is adopted with a pinger on the underwater drone and a receiver on the aerial drone. It is expected that, in future, many underwater drones may be used simultaneously. Then it will be necessary to position many pingers simultaneously. SSBL usually includes cross-correlation using FFT, which increases the load when processing many targets. To reduce the load on the SSBL receiver, we propose the iterative gradient method (IGM) be used instead of the conventional cross-correlation method. IGM can reduce the SSBL load by an order of magnitude compared to the conventional method, and even in the presence of reflected waves, the proposed method can suppress positioning errors by appropriately selecting the computation interval.

[2] A. Nishitani et.al explain Underwater inspection work performed by ships and divers is always dangerous and consumes considerable time and money. Safer and more efficient underwater inspection work is therefore an important issue. To address this, we developed a combined aerial and underwater drone system which we reported on last year. It enables remote underwater inspection over LTE (mobile network) without using a boat or diver. However, we encountered some challenges with the previous body structure and functions such as it was sometimes difficult to combine the system with the ROV, and being swept away by ocean currents or winds on the sea surface. Therefore, we have made improvements to the system to rectify these issues. Using the improved drone system, we conducted demonstration experiments in domestic coastal waters and confirmed that the improvements were effective in an actual marine environment. This paper describes in detail the improvements made to our combined aerial and underwater drone system

[3] T. Sawa et.al explain In this research, we prototyped an underwater optical wireless communication device that directly transmits and receives optical signals at the end of an optical fiber, and try to remotely control an underwater drone by the device. Since the area of the optical fiber end face is very small, lights emitted by multiple laser diodes are guided into one optical fiber with lens to brighten the light from the end. In addition, a plastic optical fiber with a large core diameter is used for receiving many optical signals in the device. First, the profile of the transmission beam and receiving beam, and the difference in output intensity from each port of the beam combiner were confirmed. Based on these results, the orientation of the end of the optical fibers are adjusted and installed on the bottom of the pool. In the remote control of the underwater drone equipped with a small optical wireless communication device, it was possible to operate with the poolside controller while checking the image of the onboard camera via optical wireless communication. The area where the drone could be controlled was almost the entire pool.

[4] A. K. Saha et al explain an underwater remotely controlled vehicle is termed as an underwater rover as it is remotely controlled from the top of the host ship above the water surface. Now the working principle of an underwater rover is not similar to a remotely controlled car or drone. So, a steel cable is of great necessity for a proper connection between the user at the host ship and the underwater rover as this is a remotely controlled rover. There lies a great variety of its application, it can be used for getting the live video or still pictures of the underwater life and all the underwater activities to learn about the underwater life. It makes the job for divers, rescuers and gem collectors easier as the rover gives the pictures, live video and all the other relevant details necessary for having a proper knowledge about the underwater elements. The underwater rover engine can be built using many types but here we are going to discuss about Raspberry Pi controlled engine underwater rover.

[5] A. Vasili jevic et al explain NTNU's Applied Underwater Robotics Lab (AU-R Lab) has been developing a full-scale subsea testing and validation facility in the Trondheim fjord since 2017. These activities are the result of NTNU's long-term collaboration with Equinor that is related to the development of a test and validation site for underwater technology, including the autonomous/resident vehicles. Infrastructure has been further developed in the scope of Subsea node of the Ocean Lab project. This paper describes Ocean Lab infrastructure, docking station, instrumentation and subsea assets, and modes of remote access to the infrastructure. Different use-cases such as: docking, remote experimentation, subsea residency and testing and validation of Underwater Intervention Drones are briefly elaborated. The paper also presents work that has been done in the Ocean Lab within the various EU Horizon projects. The aim of developing Ocean Lab infrastructure is to contribute to the development of new technology for observing the ocean, both for academia and industry; and to be part of the overall measurement system in the Trondheim fjord, allowing better understanding of the interplay in the sea.

3. METHODOLOGY

The development of the RC Underwater Exploration Drone involves a comprehensive methodology and implementation plan to ensure the successful integration of its features and functionalities. Define the specific requirements and design parameters based on the project objectives. This includes determining the size, weight, and structural components of the drone, as well as selecting suitable materials for underwater use. Identify and source the necessary components, including a high-resolution camera, bright underwater lights, brushless motors, and an electronic clamp hook. Ensure compatibility and durability of selected components in underwater conditions. Remote Control System:

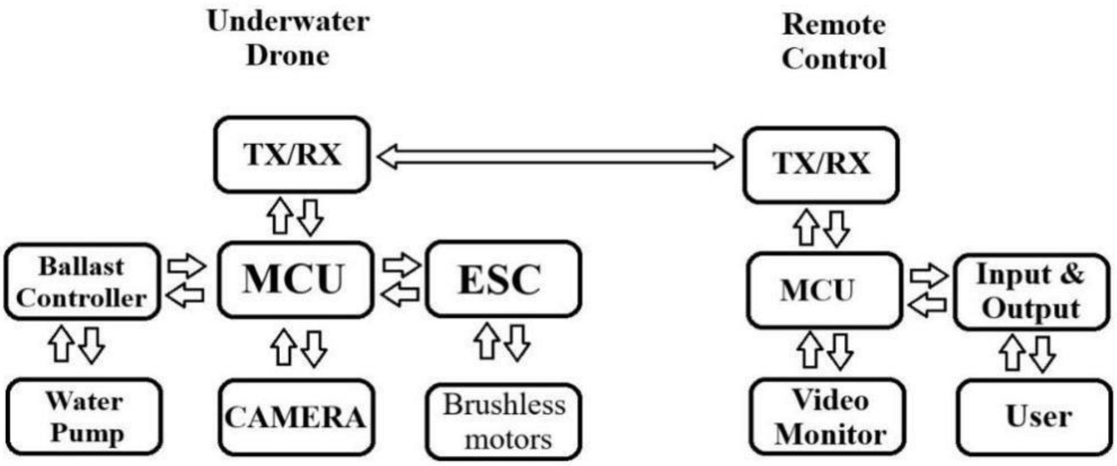

Fig 1: Block diagram RC Underwater Exploration Drone

Develop a reliable remote control system for the drone, allowing operators to navigate and control its movements with precision. Implement user-friendly controls and establish a secure communication protocol to ensure seamless operation. Design and implement the mechanism that allows the drone to dive underwater and resurface. This involves creating a waterproof enclosure for electronic components, optimizing buoyancy, and integrating a reliable propulsion system. Integrate the built-in camera with live video feed capabilities into the drone's design. Ensure that the camera is protected from water damage, and optimize its positioning for capturing clear and comprehensive visuals during exploration. Implement a high-brightness lighting system to improve visibility in underwater environments. Integrate the lights strategically to illuminate the surroundings effectively without causing glare or shadows that could affect the quality of the live video footage. Develop and implement the electronic clamp hook, ensuring it is robust and capable of securely grasping objects underwater. Integrate controls for the clamp hook into the remote control system, allowing operators to manipulate it with precision. Conduct rigorous testing in controlled underwater environments to assess the drone's performance, durability, and functionality. Iterate on the design and make necessary adjustments based on testing results to enhance overall reliability. Implement safety features, such as automatic resurfacing in case of technical issues, to ensure the protection of the drone and prevent potential damage. Incorporate fail-safes and emergency response mechanisms to address unforeseen circumstance. Develop a user interface for the remote control system and, if applicable, a mobile application for additional control and monitoring. Ensure a seamless user experience and provide necessary training materials for operators. Test and integrate the drone's capabilities for rescue operations. This involves simulating emergency scenarios and evaluating the effectiveness of the drone in locating and assisting individuals or objects in distress. Explore and implement applications for environmental monitoring, such as assessing underwater ecosystems and pollution levels. Develop data collection and analysis protocols to contribute to scientific research and conservation efforts. Prepare comprehensive documentation, including user manuals and maintenance guides, to facilitate the deployment and operation of the drone. Ensure that operators have the necessary information for effective and safe use. Develop educational materials and outreach programs to promote the project and its potential applications in schools, universities, and community organizations. Encourage engagement and interest in STEM fields related to underwater exploration and technology.

Camera

The OV7670 is a CMOS image sensor that provides full-frame windowed 8-bit images in a wide range of image formats. The sensor is controlled using a Serial Camera Control Bus (SCCB) which is an I2C interface with a maximum clock frequency of 400Khz. The OV7670 camera module offers complete frame, subsampled 8-bit images in a variety of formats which are controlled throughout the SCCB interface. The necessary image processing functions mainly include gamma, control of exposure, color saturation, white balance, hue control which are also programmable throughout the SCCB interface. The OV7670 camera module functions at 30 fps maximum & 640 x 480 resolutions which are equal to 0.3 Megapixels

ARDUINO NANO

The Arduino Uno is a popular microcontroller board that is widely used for prototyping and DIY projects. It is based on the ATmega328P microcontroller and comes with a variety of input/output pins that can be used to interface with other electronic components. To get started with the Arduino Uno, you will need a kit that includes all the necessary components. You can find a range of beginner-friendly kits on the official Arduino store2, including the Make Your UNO Kit. Other online stores such as Robu.in and Flipkart also offer Arduino Uno kits that include all the necessary components to get started with Arduino programming.

BLDC MOTOR

A brushless DC motor is an electronically commuted motor that does not have brushes. The controller provides pulses of current to the motor windings which control the speed and torque of the synchronous motor . Brushless motors are more efficient than brushed motors as they have less mechanical energy loss due to friction . The present invention relates an underwater vehicle, especially an AUV, autonomous underwater vehicle, and deals with the way the vehicle is constructed both with regard to the mechanics and how it will be connected to your display. The Drone's main frame or body will be made from PVC. We are using a non metallic element so that it cannot be detected by some modern mines which rely on magnetic properties of the target. The drone will be launched from a floating vessel or Ship using crane or a launching mechanism. The drone is connected to main vessel with help of cable. Here radio-waves are not used for controlling because they lose their strength in water while controlling using wi-fi or bluetooth offers a limited range. The operator controls all the action of the drone by sitting in the safety of the vessel. Once drone is launched into the water the thrusters are switched on. There are in total four thrusters in our drone. Two of this thrusters are using for propelling the drone while the remaining two are used to control the depth of the drone. We are using DC motors with propellers to control the movement A CMOS Camera is placed at the front of the drone for giving us live feed into the control room. The ultra sonic tranducer is placed at the bottom of the drone for detecting any mines. The ultrasonic transducer is also useful in low light conditions of underwater for propelling. The ultrasonic transducer is one of the main component used for detection. All this modules are connected to the control room through ECU or Electronic Control Unit. The microcontroller used in ECU is used to give commands to the module for functioning at the right time. It acts like a brain to the entire system. All this modules are powered using power module or battery which is placed on the ship deck. The cable used to connect ship and drone is more than 5km which placed on the deck ina rolled position. The cable is very long so that it can cover a large area without being noticed. Once drone detects the mine it can start the process of detonation. There are different processes for detonating the drone sometimes the drone acts like a torpedo and will blast once it comes in contact with the mine. While sometimes the drone will cut the cable attaching the mine to the ocean floor. We are pruposing the drone will we place a blast around the drone and will leave the mine. The blast charge will be detonated using a wire which will attached to a drone. The drone will be than called backed to the launching ship and will be assigned for future operations.

4. RESULTS AND DISCUSSIONS

The RC Underwater Exploration Drone is an innovative water drone that is engineered for efficient navigation, offering 360-degree control and live footage viewing capabilities. It is designed to maneuver easily in all directions underwater, providing 360-degree directional control, and is equipped with a camera module that transmits live video back to the operator, offering real-time insights into the underwater world. The drone uses two motors for propulsion, allowing for precise movement and stable positioning in water currents, and a separate motor manages vertical movement, working in tandem with the propulsion motors for full spatial control . The drone's components are built to withstand corrosive marine environments, ensuring longevity and durability. In our work we have used a pipe with cm diameter and a length of 1.2 feet. The pipe on which motors are mounted is 2cm in diameter and 32cm in length from end to end. We have used PVC pipe in project because of their durability. The PVC is also very light in weight which makes the drone easy to carry. On the "H" structure all the four motors are mounted and the wires are also packed inside the structure, The "H" is made using a 2cm diameter PVC

The CMOS camera is mounted on the front of the drone in a transparent casing. It is controlled using arduino. While the images from the cmos camera are displayed on the screen. In underwater surveillance drone AC motors are paired with propellers to propel the drone through water and also control the depth of the drone. The AC motor we will be using in our project will be of 220V. The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The importance of underwater exploration is multifaceted, ranging from environmental monitoring and conservation to industrial applications like dam and bridge inspections. Understanding underwater ecosystems is crucial for conservation efforts, as marine plants significantly contribute to oxygen production and biodiversity. Additionally, monitoring human impacts such as pollution and overfishing is vital for sustainable practices. The RC Underwater Exploration Drone opens up new possibilities for research, surveillance, and discovery beneath the waves. Its combination of efficient navigation, live video capabilities, and robust design makes it an invaluable tool for scientists, environmentalists, and explorers alike. With this drone, he mysteries of the deep are closer to being unveiled, one dive at a time.

5. CONCLUSION

Underwater exploration is a vital and challenging task for various scientific, industrial, and recreational purposes. RC underwater exploration drone is a novel and innovative device that enables efficient and effective underwater navigation, live video transmission, and anti-rust design. The drone uses a unique rudderless mechanism, a buoyancy control system, and a raspberry pi controller to achieve 360-degree directional control and wireless communication. The drone can be used for a wide range of applications, such as ecological studies, infrastructure inspection, pollution monitoring, and oceanography. The drone marks a significant advancement in marine technology and opens up new possibilities for discovering and understanding the mysteries of the deep. This paper has summarized our ongoing research in underwater sensor networks, including potential applications and research challenges. We presented an overview of the state of the art in underwater acoustic sensor network. We discussed characteristics of the underwater channel and outlined future research directions for the development of efficient and reliable underwater acoustic sensor networks. It will also limit the human loss due to mines. Research in underwater applications is active both from the technological and methodological point of view. Improved energy and power capability will enable longer missions, higher speeds, or better/additional sensors. The goal is to develop fully autonomous, reliable, robust decision making autonomous drones. There are still communication problems that are need to be solved

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