RESCUE-READY UNDERWATER SURVEILLANCE DRONE WITH REAL-TIME CAMERA FEED

A Project Report

Submitted in partial fulfilment of the requirement for the award of the degree

Bachelor of Engineering

In

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Submitted By

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(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

Certified that the major project work titled **"RESCUE-READY UNDERWATER SURVEILLIANCE DRONE WITH REAL TIME CAMERA FEED"** is carried out by **RISHABH NARENDRA(1MJ21EC112),S LAVANYA(1MJ21EC114), VANI KABADAGI (1MJ21EC156),YASASWITHA DESU (1MJ21EC168)** who are confide students of MVJ College of Engineering, Bengaluru, in partial fulfilment for the award of Degree of **Bachelor of Engineering in Electronics and communication Engineering** of the Visvesvaraya Technological University, Belagavi during the year 2024-2025. It is certified that all corrections/suggestions indicated for the Internal Assessment have been incorporated in the major project phase I report deposited in the departmental library. The major project phase-I report has been approved as it satisfies the academic requirements in respect of major project work prescribed by the institution for the said Degree.

Signature of Guide	Signature of Head of the Department	Signature of Principal
Dr. THIALAGARAJ Associate Professor Dept. of IOT MVJ College of Engineering Bengaluru	**Dr. SHIMA RAMESH MANIYATH** Head of the Department Dept. of ECE MVJ College of Engineering Bengaluru	**Dr. AJAYAN K R** Principal MVJ College of Engineering Bengaluru

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Name of Examiners	Signature with Date
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2.	

MVJ COLLEGE OF ENGINEERING, BENGALURU-560067

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DECLARATION

We, RISHABH NARENDRA (1MJ21EC112) , S LAVANYA (1MJ21EC114), VANI KABADAGI (1MJ21EC156) and YASASWITHA DESU (1MJ2EC168) students of seventh semester B.E., Department of Electronics and Communication Engineering, MVJ College of Engineering, Bengaluru, hereby declare that the major project titled **'RESCUE READY UNDERWATER DRONE WITH REAL TIME CAMERA FEED '** has been carried out by us and submitted in partial fulfilment for the award of Degree of **Bachelor of Engineering** in **Electronics and Communication Engineering** during the year 2024-2025.

Further we declare that the content of the dissertation has not been submitted previously by anybody for the award of any Degree or Diploma to any other University.

We also declare that any Intellectual Property Rights generated out of this project carried out at MVJCE will be the property of MVJ College of Engineering, Bengaluru and we will be one of the authors of the same.

Place: Bengaluru

Date:

Name **Signature**

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We are indebted to our guide**, Dr. THILAGARAJ** Associate Professor**, Dept of IOT Engineering, MVJ College of Engineering** for his wholehearted support, suggestions and invaluable advice throughout our project work and also for the help in the preparation of this report.

We thank to all the technical and non-technical staff of Electronics and Communication Engineering department, MVJCE for their help.

ABSTRACT

The usage of underwater drones for marine surveillance has gained significant attention in recent years. These remotely operated vehicles offer a unique and cost-effective approach to monitoring and exploring the underwater environment. This provides an overview of the key developments, challenges, and emerging trends in the field of underwater drones for marine surveillance. Underwater drones, encompassing remotely operated vehicles (ROVs) have witnessed significant development, evolving from simple prototypes to advanced and complicated, purpose-built vehicles. The advancements in technology have expanded their applications across diverse domains, including environmental monitoring, maritime security, scientific research, and offshore industries. Critical components of underwater drones, such as propulsion systems, sensors, Communication systems, and navigation controls, have undergone substantial innovation, enabling enhanced capabilities for marine surveillance. These technological developments have been instrumental in addressing complex challenges in the underwater realm. But certain limitations, notably power constraints, communication range, and environmental impact, persist.

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CHAPTER-1

INTRODUCTION

CHAPTER 1

Introduction

Ocean cover around 71% of the planet and 44% of the World's population is living along coastline. Oceans is the main sources of many natural resources including oil mineral such as nickel, cobalt, even salt and sand. Now a day's, main problem in Seas and Lakes is people are falling / grabbing in to water by the force generated by the water, damages under the ship bottom generated by the sea, loosed items under water, etc… They are many types of Rescue systems are available in the world which are operated on the surface of the water areas only but not work under water perfectly. The professional divers also stay up to max 20Min under the water it is due to the lack of sufficient oxygen levels under water. Now a day the UAV vehicles are highly developed drone technologies enables the use of drones in a wide variety of areas such as in aerial photography for appreciating the beauty of nature, in natural disasters where direct human intervention is impossible, or in agriculture for spraying pesticides to exterminate noxious Insects.

Furthermore, amazon is preparing to use drones for delivering packages to customers. In a word, drone technology brings innovation and opens new markets. However, these drones are limited to the unmanned aerial vehicles. We believe that underwater drones, which are autonomous robots capable of moving and operating in the water, will become a big research topic and find a market in the near future.

A camera acting as an "eye" is an essential component of a drone. A grabbing arm is used to help to push / pull objects and classifying the objects. For example, to perform the rescue operation to save the person who is shrinking under the water, investigating damages under the ship bottom, searching loosed items, under water search operations up to 45min it may help to investigate and observes fish species in a lake, check the aging process of the walls of a dam, and so on.

We developed an underwater drone that combines the hottest keywords in today's drone technology: "Wide angle Camera", "underwater drone", "Rescue", "Surveillance", "Inspection", "deep learning", and "open-source hardware". Our model is designed based on open-source hardware, is equipped with a function of wide-angle camera, and has the ability of transmitting live video footage. The body was designed using a free software application for creating solid 3D computer-aided design objects (Open CAD). The printed-circuit board was designed with frizzing. The underwater drone was equipped with wide angle camera lenses. The goal of this research was to use the underwater drone for investigating and observing the lakes, seas, and so on.

CHAPTER-2

LITERATURE SURVEY

CHAPTER 2

LITERATURE SURVEY

Supriya S. Telsang et al. year 2024 [1] this paper is "Underwater Exploration and Cleaning Drone" This project introduces a novel underwater drone capable of remote-controlled movement and real-time communication. Equipped with a camera and sensors, the drone can sample and analyse water, providing real-time images, pH values, and turbidity levels. Controlled via Bluetooth technology, it facilitates underwater exploration, cleaning, and water quality monitoring.

Dr. Shivananda, N.S et al. year 2024 [2] this paper is "RC Under Water Exploration Drone" This paper discusses the design of an underwater drone equipped with a built-in camera providing live video feed, enabling real-time monitoring of the underwater environment. The drone is designed for underwater exploration and can be utilized in search and rescue missions.

Quan-Dung Pham et al. year 2023 [3] this paper is "UWA360CAM: A 360° 24/7 Real-Time Streaming Camera System for Underwater Applications" This paper presents UWA360CAM, a comprehensive system designed to provide continuous 360-degree real-time streaming for underwater environments. The system addresses challenges such as sensor resolution, wide field of view, power supply, optical design, system calibration, and overheating management, making it suitable for various marine applications.

Juan P. Martinez-Esteso et al. year 2023 [4] this paper is "Maritime Search and Rescue Missions with Aerial Images: A Survey" This survey examines the utilization of drones equipped with high-resolution cameras in maritime search and rescue missions. It discusses the effectiveness of various imaging technologies, including

thermal and multispectral cameras, in enhancing the detection and rescue of individuals in distress at sea.

J. Mounika et al. year 2023 [5] this paper is "Under Water Surveillance and Rescue Drone with Camera" The primary objective of this research is to develop an underwater surveillance and rescue drone equipped with a camera to assist in saving individuals submerged underwater, inspecting damages beneath ships, and conducting underwater research operations.

Ishrat Jacy Meem et al. year 2022 [6] this paper is "Semi Wireless Underwater Rescue Drone with Robotic Arm" This paper introduces a semi-wireless underwater rescue drone equipped with a robotic arm capable of retrieving objects underwater. The drone features a 4K HD camera and waterproof lights to facilitate search and rescue operations.

Xiaomin Lin et al. year 2022 [7] this paper is "SeaDroneSim: Simulation of Aerial Images for Detection of Objects Above Water" This study presents SeaDroneSim, a simulation suite designed to create photorealistic aerial image datasets with ground truth segmentation masks for objects above water. The tool aims to facilitate the development of computer vision algorithms for UAVs in maritime search and rescue operations.

Tejas Nandurkar et al. year 2021 [8] this paper is "Underwater Surveillance Drone with Camera" The primary objective of this research is to examine the evolution and capabilities of underwater drones, also known as unmanned underwater vehicles (UUVs), equipped with cameras for surveillance purposes. The study discusses the design and implementation of such drones for real-time monitoring of underwater environments.

Agnieszka A. Tubis et al. year 2021 [9] this paper is “Risks of Drone Use in Light of Literature Studies” This article reviews the potential risks associated with drone usage across various domains, including underwater applications. It discusses safety concerns, regulatory challenges, and technological limitations, providing a comprehensive overview of the current state of drone utilization.

Md Jahidul Islam et al. year 2020 [10] this paper is “Simultaneous Enhancement and Super-Resolution of Underwater Imagery for Improved Visual Perception” The paper introduces 'Deep SESR,' a generative model designed to enhance and increase the resolution of underwater images simultaneously. Aimed at improving visual perception for underwater robots, the model employs a multi-modal objective function to address colour degradation, lack of sharpness, and feature loss in underwater imagery. Experimental evaluations indicate that Deep SESR outperforms existing solutions, offering real-time applicability for underwater robotic operations.

Monika Roznere et al. year 2020 [11] this paper is “Real-time Model-based Image Colour Correction for Underwater Robots” This paper proposes a real-time colour correction method for underwater robots, integrating a new imaging formation model that accounts for water type, camera specifications, depth, and imaging range. The method utilizes data from depth sensors and visual odometry to enhance image quality, which is crucial for applications like 3D reconstruction and robust underwater navigation.

Lin Meng et al. year 2020 [12] this paper is “Underwater-Drone with Panoramic Camera for Automatic Fish Recognition Based on Deep Learning” This paper presents the development of an underwater drone equipped with a 360-degree panoramic camera designed for automatic fish recognition. The system utilizes deep learning techniques to identify fish species in natural lakes, aiding in environmental.

CHAPTER-3

METHODOLOGY

CHAPTER-3

Methodology

3.1 EXISTING SYSTEM

The current systems of rescue-ready underwater surveillance drones with real-time camera feeds are advanced devices designed for underwater exploration, rescue missions, and surveillance tasks. These drones, also known as ROVs (Remotely Operated Vehicles), provide real-time visual and data feedback to operators for enhanced situational awareness in underwater environments.

Key Features:

1.Real-Time Camera Feed: Equipped with high-definition (HD) cameras capable of capturing clear visuals underwater. Live video is transmitted to the surface via a tether (wired) or wireless systems. Often includes low-light or infrared cameras for operations in dark or murky waters.

2. Navigation and Control: Controlled via a remote or mobile application. Uses advanced technologies like sonar, GPS, and gyroscopes for precise navigation. Autonomous or semi-autonomous modes allow drones to perform pre-programmed tasks.

3. Depth and Durability: Operates at depths ranging from 50m to over 300m, depending on the model. Built with waterproof materials, pressure-resistant housings, and corrosion-resistant components.

4. Additional Features: Robotic arms for picking up objects or performing tasks. Sensors for water quality testing (e.g., temperature, pH, salinity).LED lights for better visibility in low-light conditions.

3.2 PROPOSED SYSYTEM

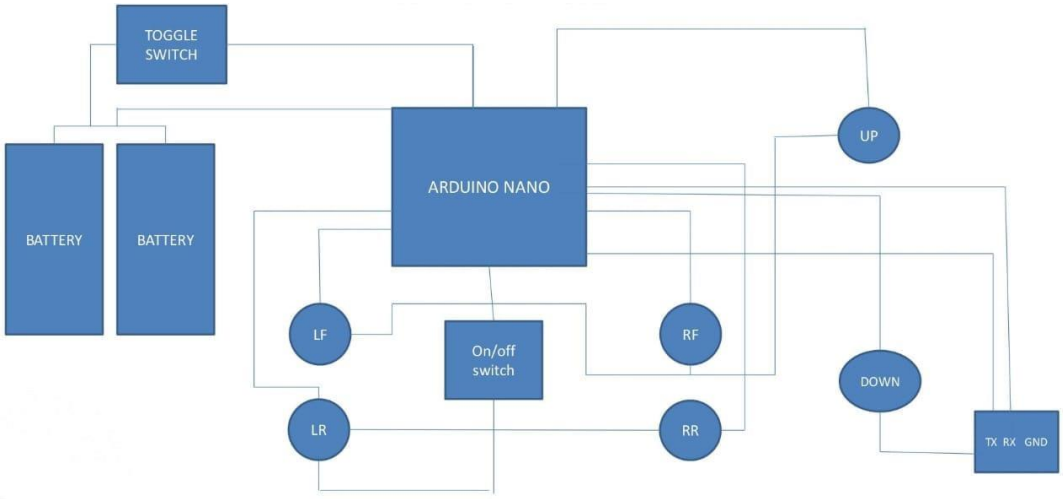

FIG NO 3.1: BLOCK DIAGRAM OF SURFACE CONTROLLER

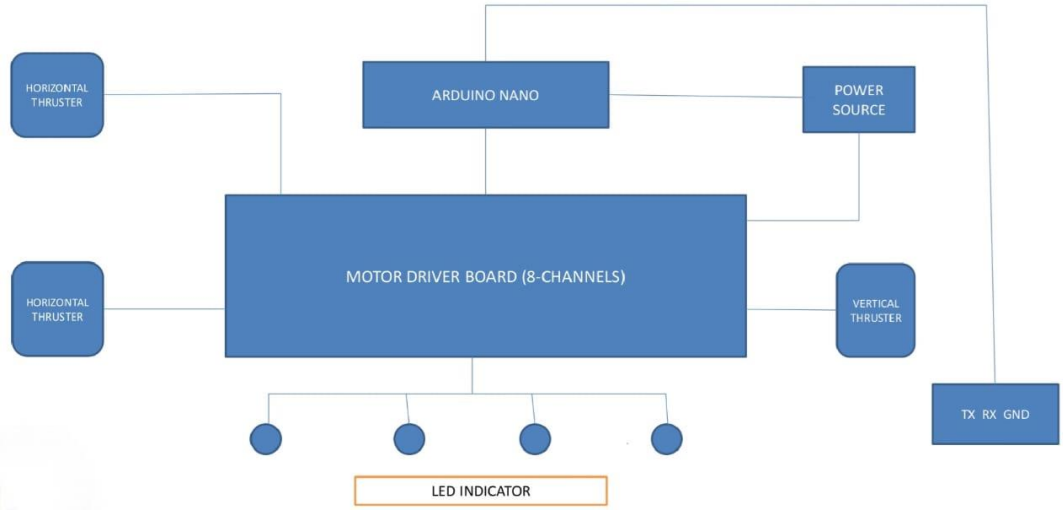

FIG NO 3.2: BLOCK DIAGRAM OF ON-BOARD CONTROLLER

A proposed system for a rescue-ready underwater drone with a real-time camera feed would be designed to address the specific needs of underwater search and rescue operations, combining advanced technology, reliability, and ease of use for critical missions. Here's an outline of such a system: Real-time HD/4K Camera Feed: High-Definition or 4K cameras for superior image quality, enabling the drone to provide clear visual feedback during rescue operations.360° rotation for full situational awareness, allowing operators to assess large areas quickly. Low-light capabilities for operations in dark or murky waters, using infrared or LED lighting. Advanced Navigation and Control: High-precision GPS for surface navigation and tracking.

Underwater navigation systems, such as sonar, magnetometers, and depth sensors, to assist in manoeuvring and detecting submerged objects or people. Pressure sensors to prevent damage to the drone at significant depths (up to 300m or more).

Joystick or app-based control for ease of operation by trained personnel, with options for autonomous behaviour like path following, search patterns, or obstacle avoidance.

Tethered or Wireless Communication: Tethered version: Provides continuous power and a stable real-time video feed. High-quality fibre optic cable or coaxial cable for high-bandwidth data transmission.

Wireless version: Uses Wi-Fi, acoustic modems, or 4G/5G (with limitations in deep water) to communicate with the surface unit. Provides flexibility for short-to-medium-range rescue operations.

CHAPTER-4

HARDWARE AND SOFTWARE REQUIREMENTS

CHAPTER 4

Hardware and Software Requirements

4.1 HARDWARE REQUIREMENTS

1.ARDUINO NANO

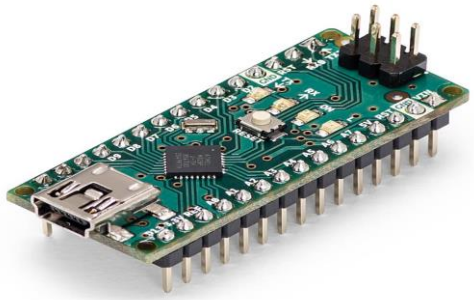

FIG NO 4.1: ARDUINO NANO

The Arduino Nano is a compact microcontroller board based on the ATmega328P. It features a small form factor, making it suitable for projects with limited space. Key components include:

- Microcontroller: ATmega328P, operating at 16 MHz
- Input Voltage: 6-12V (via VIN) or USB power.
- I/O Pins: 14 digital pins (6 PWM), 8 analog input pins.
- Connectivity: Mini USB port for programming and power.

2.8 CHANNEL RELAY MODULES

An 8-channel relay module is an electronic device used to control high-voltage electrical loads using low-voltage control signals, typically from a microcontroller like an Arduino or Raspberry Pi. Here's a basic summary:

- Relays: Contains 8 relays that can switch devices on/off independently.

- Voltage Control: Operates on a 5V or 12V input signal depending on the model.
- Load Capacity: Each relay can control up to 250V AC or 30V DC with a typical maximum current of 10A.
- Control Pins: Includes 8 control pins to interface with a microcontroller for activating each relay.

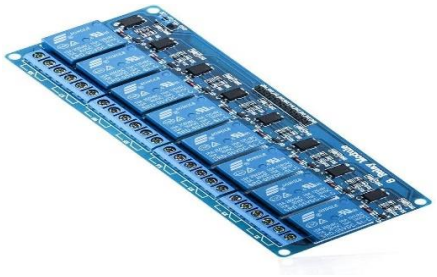

FIG NO 4.2: 8 CHANNEL RELAY MODULE

3. 12 V BATTERY

A 12V battery is a common power source used in a variety of applications, including automotive, marine, solar, and uninterruptible power supplies (UPS). Its nominal voltage is 12 volts, typically achieved by connecting six 2V cells in series

Key specifications include:

- Capacity (measured in Ah): Indicates how long the battery can deliver current.
- Voltage: Nominal 12V, but fully charged it can be around 12.6V–13.2V.

- Life cycle: Varies based on battery type and usage conditions. Common uses include powering electronics, starting engines, and storing renewable energy

FIG NO 4.3: 12V BATTERY

4.ON/OFF SWITCH

An ON/OFF switch is a simple electrical switch used to control the flow of current in a circuit, allowing a device to be powered on or off. It is one of the most basic and commonly used types of switches.

Key Features:

- Operation: Toggles between two states: ON (closed circuit) to allow current flow and OFF (open circuit) to stop current flow. Typically operated manually by pressing, flipping, or sliding.
- Design: May come in various forms such as a toggle, rocker, push-button, or slide switch. Available in single-pole or multi-pole configurations.

FIG NO 4.4: ON/OFF SWITCH

5.RCA CABLE

An RCA cable is a type of electrical cable used to transmit audio and video signals between devices. It is a widely used, low-cost solution for connecting various consumer electronics.

Key Features:

- Design: Composed of one or more color-coded connectors. Typically has male connectors on both ends, which plug into female jacks. Common colours: Red and White: For stereo audio (right and left channels). Yellow: For composite video.
- Signal Type: Analog signals (not digital). Can carry audio, video, or both, depending on the cable type.
- Applications: Connecting TVs, DVD players, game consoles, and speakers. Linking home theatre systems. Older devices without HDMI support.

FIG NO 4.5: RCA CABLE

6.TOGGLE SWITCH

A toggle switch is a type of mechanical switch that is manually operated by a lever or handle to open or close an electrical circuit. It is commonly used in various electrical and electronic applications due to its simplicity and reliability.

Key Features:

- Operation: Moves between two or more positions (e.g., ON/OFF, ON/ON, or ON/OFF/ON). The lever or handle "toggles" to change the state of the circuit.
- Types: Single Pole Single Throw (SPST): Basic ON/OFF switch for a single circuit. Single Pole Double Throw (SPDT): Switches between two circuits. Double Pole Double Throw (DPDT): Controls two independent circuits simultaneously.
- Ratings: Designed to handle specific voltage and current levels (e.g., 12V, 24V, 110V; 5A, 10A).
- Mounting Styles: Panel-mounted/ PCB-mounted, depending on application requirements.

FIG NO 4.6: TOGGLE SWITCH

7.18650 BATTERY

The 18650 battery is a widely used rechargeable lithium-ion battery named after its dimensions: 18mm in diameter and 65mm in length. It is commonly used in various applications due to its high energy density, durability, and reliability. Here's a summary:

Key Features:

- Voltage: Nominal voltage is typically 3.6V–3.7V, with a fully charged voltage of around 4.2V and a discharged voltage of about 2.5V–3.0V.
- Capacity: Ranges from 1500mAh to 3500mAh, depending on the manufacturer and type.

- Chemistry: Common chemistries include Lithium Cobalt Oxide (LiCoO2), Lithium Manganese Oxide (LiMn2O4), and Lithium Iron Phosphate (LiFePO4).The most common is Li-ion (LiNiMnCoO2) for its balance of energy density and safety.

FIG NO 4.7 :18650 BATTERY

8. 48mm PROPELLER

A 48mm propeller is a small rotary device typically used in RC (remote-controlled) boats, drones, or other model vehicles to provide propulsion by converting motor power into thrust.

Key Features:

- Size: The 48mm refers to the diameter of the propeller (measured tip-to-tip). Suitable for smaller RC models or specific speed and performance requirements.
- Material: Commonly made of plastic, nylon, or metal (aluminium, brass, or stainless steel) depending on durability.

FIG NO 4.8: PROPELLER

9. MOMENTARY PUSH BUTTONS

A momentary push button is a type of switch that remains active only while being pressed. Once released, it returns to its original state. It typically has two main states:

- Normally Open (NO) – The circuit is completed when the button is pressed.
- Normally Closed (NC) – The circuit is broken when the button is pressed.

FIG NO 4.9 :MOMENTARY PUSH BUTTONS

10. TWISTED TWIN CABLE

Twisted Twin (TT) Cables are specialized electrical cables used primarily for powering and connecting LED lighting systems. They are designed to ensure efficient power delivery and reduce interference, making them ideal for LED applications.

Key Features:

- Twisted Design:The twin conductors are twisted together to reduce electromagnetic interference (EMI) and signal loss, ensuring stable performance.

FIG NO 4.10: TWISTED TWIN CABLE

11. BILGE PUMP (AS THUSTHER)

A bilge pump is a device used to remove water that accumulates in the bilge (the lowest part of a boat's hull). It is essential for maintaining buoyancy and safety in marine vessels.

Key Features:

- Purpose: Removes water caused by leaks, rain, or splashing to prevent flooding or sinking.
- Types: Manual Bilge Pump: Operated by hand; simple and reliable.
- Electric Bilge Pump: Powered by the boat's battery and controlled via a switch or float sensor.

FIG NO 4.11: BILGE PUMP

12. 1W LED

A 1W LED is a high-power light-emitting diode capable of producing significant brightness while consuming only 1 watt of electrical power. Here's a basic summary:

- Power rating: 1 Watt
- Luminous efficiency: Typically ranges between 80-120 lumens per watt
- Forward voltage: Around 3V
- Forward current: Approximately 350mA

FIG NO 4.12: LED

13.FPV CAMERA

Building an FPV (First Person View) camera using an Arduino Nano involves integrating a small camera module, a wireless video transmitter, and a display. The Arduino Nano itself does not handle video processing due to its limited processing power.

Components Required:

- FPV camera (e.g., a mini CMOS or CCD camera).
- Video transmitter module (VTX).
- Receiver (VRX) with a compatible monitor or goggles.
- Arduino Nano (for controls like pan/tilt or telemetry).

FIG NO 4.13: FPV CAMERA

4.2 SOFTWARE REQUIREMENTS

1. Arduino IDE

2.DVD Maker

CHAPTER-5

IMPLEMENTATION

CHAPTER-5

IMPLEMENTATION

5.1 CIRCUIT DIAGRAM

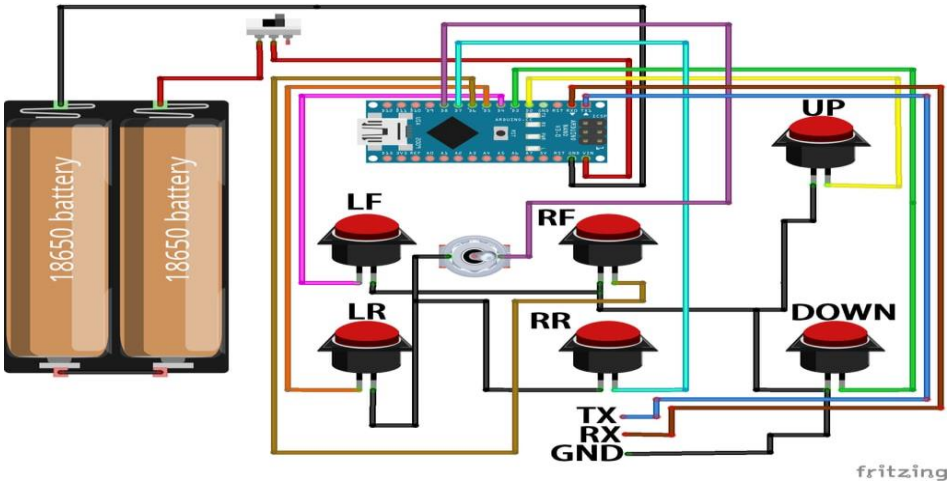

FIG NO 5.1: SURFACE CONTROLLER

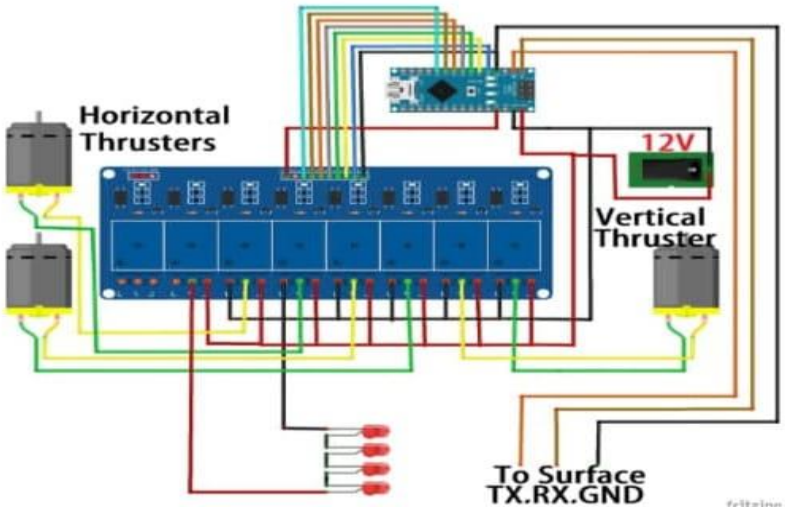

FIG NO 5.2: ON-BOARD CONTROLLER

5.2 WORKING

A rescue-ready underwater drone with real-time camera feed is designed to help with underwater search and rescue missions, environmental monitoring, and inspections. Here's how it typically works. Frame & Propulsion System The drone has a durable, waterproof frame and multiple thrusters for 3D movement (forward, backward, vertical, horizontal). Camera System - Equipped with a high-resolution real-time camera, often with low-light or infrared capabilities to operate in murky waters or low visibility. Some models also feature a pan-tilt mechanism for better viewing angles. Control Unit A surface-level remote control system or base station connected via a tether cable or wireless link. Includes a monitor to display the live video feed from the underwater camera. Sensors Depth sensors, sonar, and gyroscopes for stability and navigation. Some advanced drones also use LiDAR for 3D mapping. Tether Cable Many underwater drones use a tether for power and data transmission, ensuring reliable real-time video and control in deep water. Power Supply Either battery-powered or connected to a surface-level power source via the tether. Deployment. The drone is deployed into the water, and the operator uses the control unit to makeover it. Navigation & Operation Using the onboard sensors and thrusters, the operator navigates the drone through water. The camera provides a continuous real-time video feed, displayed on a monitor. The operator can control the camera’s orientation to scan specific areas or objects.

CHAPTER-6

RESULT

CHAPTER-6

RESULT

As the result we have contructured the outer frame work with the PVC pipes and we contructured the surface controller which can be used for operating the model of on-board controller to pass the Tx, Rx and GND by this we can operate the model.

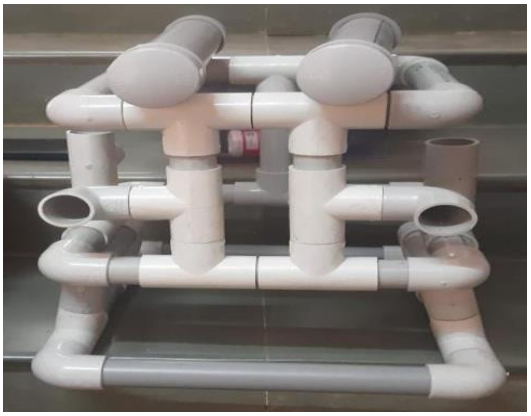

FIG NO. 6.1: OUTER FRAME WORK

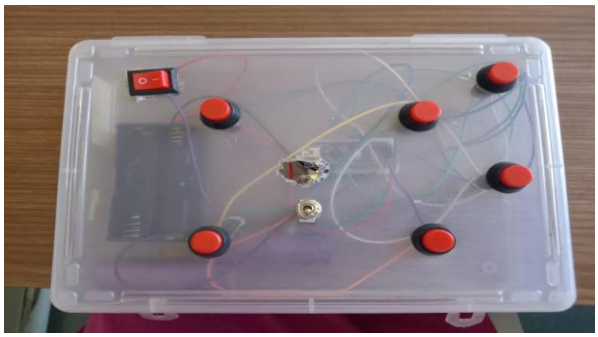

FIG NO. 6.2: DESIGN OF SURFACE CONTROLLER

CHAPTER 7

CONCLUSION & FUTURE SCOPE

CHAPTER 7

CONCLUSION & FURURE SCOPE

7.1 CONCLUSION

In conclusion, the rescue-ready underwater surveillance drone equipped with a real-time camera feed represents a transformative solution for underwater operations. Its advanced capabilities, such as live video streaming, precise manoeuvrability, and robust design, make it an essential tool for search and rescue missions, underwater inspections, environmental monitoring, and maritime security. By providing real-time situational awareness, the drone enhances efficiency, reduces risks to human divers, and facilitates timely decision-making. This innovative technology paves the way for safer and more effective underwater operations in diverse scenarios.

7.2 FUTURE SCOPE

The future scope for a rescue-ready underwater surveillance drone with real-time camera feed is highly promising, given the increasing need for advanced technologies in marine exploration, disaster management, and security. Below are some areas where this technology can have significant applications and opportunities for growth. Disaster Response and Rescue Operations Search and Rescue Missions: Drones can assist in locating survivors in underwater shipwrecks, flooded areas, or during natural disasters like tsunamis and hurricanes. Disaster Assessment: Real-time feeds can help assess underwater infrastructure damage (e.g., bridges, dams) to aid rapid response. Maritime Security and defence Border Patrol: Used for monitoring unauthorized underwater activities like smuggling or illegal fishing. Naval defence: Assisting military operations in detecting underwater mines, intruding submarines, or monitoring enemy activities.

References

[1] Supriya S. Telsang “Underwater Exploration and Cleaning Drone” (2024) This project introduces a novel underwater drone capable of remote-controlled movement and real-time communication.

[2] Dr. Shivananda, N.S “RC Under Water Exploration Drone” (2024) This paper discusses the design of an underwater drone equipped with a built-in camera providing live video feed.

[3] Quan-Dung Pham “UWA360CAM: A 360° 24/7 Real-Time Streaming Camera System for Underwater Applications” (2023) This paper presents UWA360CAM, a comprehensive system designed to provide continuous 360-degree real-time streaming for underwater environments.

[4] Juan P. Martinez-Esteso “Maritime Search and Rescue Missions with Aerial Images: A Survey” (2023) This survey examines the utilization of drones equipped with high-resolution cameras in maritime search and rescue missions.

[5] Ishrat Jacy Meem “Semi Wireless Underwater Rescue Drone with Robotic Arm” (2022) This paper introduces a semi-wireless underwater rescue drone equipped with a robotic arm.

[6] Tejas Nandurkar “Underwater Surveillance Drone with Camera” (2021) The primary objective of this research is to examine the evolution and capabilities of underwater drones.

[7] Md Jahidul Islam “Simultaneous Enhancement and Super-Resolution of Underwater Imagery for Improved Visual Perception” (2020) The paper introduces 'Deep SESR,' a generative model designed to enhance and increase the resolution of underwater images simultaneously.