A PROJECT REPORT

ON

"ROV Underwater Surveillance Drone "

Submitted in partial fulfilment of the requirement for the award of

DIPLOMA IN

ELECTRONICS AND TELECOMMUNICATION ENGG

SUBMITTED BY

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Academic Year 2022-2023

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CERTIFICATE

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LIST OF ABBREVIATIONS

SR.NO	FULL FORM	SHORT FORM
1	Unmanned Underwater Vehicles	UUVs
2	Manned Underwater Vehicles	MUVs
3	Autonomous Underwater Vehicles	AUVs
4	Remotely Operated Vehicle	ROV
5	Closed-Circuit Television	CCTV
6	Cable-Controlled Underwater Research Vehicle	CURV
7	Alternating Current	AC
8	Direct Current	DC
9	Lithium Polymer	LiPo
10	Electric Speed Control	ESC
11	Universal asynchronous receiver transmitter	UART
12	Revolution Per Minute	RPM
13	Integrated Circuit	IC
14	Radio Frequency	RF
15	Transmitter	TX
16	Receiver	RX
17	Metal Oxide Semiconductor Field Effect Transistor	MOSFET
18	Normally Open	NO
19	Normally Closed	NC
20	Light Emitting Diode	LED
21	Giga Hertz	GHz

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ABSTRACT

Water covers over 70% of mass on earth. There lies a vast unexplored land beneath the seas. Moreover, underwater surveillance, videography plays a vital role in a wide range of applications. From dam and bridge inspections to fishing surveillance to sea life videography and oceanography underwater inspection is a very common need.

Also, underwater inspection will help us to keep track of sea life conservation, pollution monitoring in seas as 50 to 80% oxygen we breathe is produced by sea planktons and other sea plants. Extensive damage to seas by pollution and overfishing can cause great damages cross the globe. So here we develop a underwater inspection drone that can navigate easily underwater and allow us to vide live video footage underwater.

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 are 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 Wi-Fi to check the footages. The system makes use of a raspberry pi controller for footage transfer as well as Wi-Fi transmission.

Also, the buoy unit is used to pull out the drone in case it gets stuck or runs out of battery under water.

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1.INTRODUCTION

1.1 Definition of ROV

In the advanced development of technology today, the use of robotics which is a mixed application of mostly from mechanical and electrical area has be able to provide humans with easiness in performing hard tasks and jobs onshore, offshore, on air and underwater applications. However, we can see that the underwater technology and machine has now become more interesting as the exploration of the sea is increasing and developing.

Examples of the developing underwater technology and machines are the use of wind and wave as renewable energy and the construction of underwater vehicles. Underwater vehicles fall into two categories that are Unmanned Underwater Vehicles (UUVs) and Manned Underwater Vehicles (MUVs). Classification of these two categories can be further divided into the sub categories. According to definition made by the US Navy, UUV in other terms can also be defined as

Autonomous Underwater Vehicles (AUVs) where UUV definition is;

Self-propelled submersible whose operation is either fully autonomous (preprogrammed or real time adaptive mission control) or under minimal supervisory control and is untethered except, possibly for data links such as a fiber optic cable.

The difference between AUV and ROV is that the absence of direct hardwires communication between the vehicle and the surface. Remotely Operated Vehicle (ROV) is a tethered underwater robot, commonly used for the underwater jobs.

An ROV is also defined as a waterproof set of equipment with a camera mounted in a waterproof enclosure, thrusters for maneuvering, attached to a cable to the surface which signals are transmitted.

1.2 Background of study

Remotely Operated Vehicle (ROV) is a tethered underwater robot, commonly used for the underwater tasks. ROV operation is conducted by a control box from a remote location such as on land or on the surface of the vessel [1]. In details, basic parts of ROV can consist of:

i. Controller and navigation circuit
ii. Thrusters for maneuvering (propulsion)
iii. Lamps
iv. Camera
v. Frame
vi. Buoyancy system
vii. Tether management

Technically, ROV business however had long ago growing internationally however, there are still very few of ROV manufacturers and suppliers in Malaysia. Instead of assisting an oil and gas industry, ROV functions can be expanded to many scopes such as to search and rescue, education, underwater exploration, fisheries and ship wrecking investigation.

1.3 Problem Statements

Subsea tasks and jobs are not widely known to the public as one of most famous and important jobs. However, the fact where only people with certain skills and special knowledge can undertake and implement underwater jobs successfully and hence, ensuring that human life goes well. As examples, subsea jobs are said to be important because if offers human with great values in modern technology as well as food supply, hydrocarbon well and many others. Among the examples are:

i. Underwater electricity generation (wind and wave turbine)
ii. Exploration of oil and gas industry
iii. Fisheries industry
iv. Education

v. Discovery of earth core geology trough underwater medium

vi. Marine park and tourism

vii. Inspection of ship wreckage

viii. Marine biology and archeology

ix. Armed services and police

The importance of ROV in oil and gas industry where ROV is needed when the problems occur at the oil rig. The faulty is due to malfunction of blow out pressure that cause the oils to spill out more when the pipeline is damaged. Thus, ROV is sent to the underwater to fix for the malfunction blow out valve.

1.4 Significance of Project

ROV used in the technology development today has boosted a lost of industry confidence and where a prediction of the ROV as a new technology for past 20 years had proven true. Thus, due to all the reasons mentioned earlier, a scaled down ROV seems appropriate for this project. Scaled down version of ROV can be expanded in terms of its functions as previously stated.

The small size ROV, or ROV prototype, seems will be very useful for education purposes where children can use the ROV prototype for exploration in rivers or lakes. As for security industry, ROV prototype provides underwater closed-circuit television (CCTV) security video for shipping business. In other words, it also offers a mean of intervention, theoretically applied for all depths without any limitations. This tether vehicle control signals and power for CCTV, lights, the propulsion and its buoyancy system and the most important of its feature is the ability to provide human with navigation and control.

Other than that, it will be very beneficial to the fishing industry where the fisherman can use their own portable ROV to check for the location with high intensity of fish population. By considering all the expanded functions of ROV, the prototype for the Final Year Project (FYP) will be designed as portable, easy to handle and small in size, easy enough for the user to carry around and accomplished simple tasks.

1.5 Main Objectives

i. To study and analyze ROV designs and improvised the system

ii. To develop electrical system configuration for the prototype

iii. To obtain an optimal design of ROV

1.6 Scopes of Study

The scope of this project is to understudy all the matters involve with the designing, structuring and building the portable ROV system. After the studies has complete, the fabricating process of the ROV prototype will be done, where the process involve are:

i. Determination of power distribution system

ii. Navigation and control system

iii. Visual and light control system iv. Buoyancy and propulsion system

Improvements and testing method take precedence in the end of the project.

1.7 Project Relevance

ROV prototype can give a lot of benefits to human being. As for achieving all the objectives, ROV prototype is more than enough. The construction on ROV prototype can be used for education where the children will be able to experience themselves on maneuvering the ROV as the ROV is a tethered device. The concept of controlling the ROV is about the same with the controller used to the toy racing car and mini aircraft, but it only differs in wireless control.

As for maximum of three meters depths, the material needed in order to build the ROV might consume less cost with its basic functions stay the same. The model will also help a lot in fishing and in conserving the marine park activities that is crucial for the future.

2.LITERATURE REVIEW

The evolution of the ROV started with the very first remotely operated vehicle (ROV) [The POODLE], which was developed in 1953 by Dimitri Rebikoff. This underwater vehicle was designed for the shear purpose of archaeological research. The premature ROV was “nothing but a problem: their bottles leaked, their hydraulics failed, sunlight damaged them, they were too noisy, unreliable, hard to control and needed constant maintenance.” (Wernli,1998)

The ROV soon saw the brink of evolution due to numerous technological breakthroughs by entrepreneurs, making the ROV more functional. That being said, the first piece of remarkable work towards an operational ROV system came from the US Navy in 1961. This breakthrough was at the hand of a problem encountered by the Navy; whereby the recovery of lost torpedoes from the sea floor was priority.]

This success was marked by the introduction of the VARE vehicle, the VN-3, which was literally a maneuverable-mobile underwater camera system. Of which this design eventually became Cable-Controlled Underwater Research Vehicle (CURV), which made The US national headlines;

Following the success of Navy work, the next steps of progression came from the commercial industry. ROVs were introduced to the commercial industry by a scheme that sent ROVs to conduct offshore oil operations. This scheme led to the expansion of the commercial ROV industry, led by the North American giants (Hydro Products, AMETEK and Perry Offshore) who were responsible for 229 of 340 industrial vehicles produced between 1975 and 1984.

A few years after this introduction, ROVs became the norm in the oil industry, as they were able to reach depth ranges that human divers could not attain. For oil companies this was an opportunity for them to advance in technology. To

allow an increased market share with the new class of smaller and more reliable ROVs, these ROVs became easily portable and
economical, which meant that civil organizations and academic institution could afford them.

The 1990s marked the ‘perfection’ of the ROV industry as the US Navy turned their attention to an achievement that had not been made by this family of vehicles. The Navy set out to reach a maximum depth of 20,000 feet (6,096 m), which was accomplished in 1990 with the CURV III and ATV. Of which the CURV III reached a depth of 20,105 feet (6,128 m), this record was broken less than a week after it was recorded by the ATV with a depth of 20,600 feet (6279m).

Respectively, it wasn’t long before Japan not only beat the record but annihilated the record. Aided by JAMSTEC’s ‘Kaiko’ ROV, Japan reached the maximum depth of 35791 feet (10,909 m) – a record that can be tied but never exceeded. Since then the ROV industry has grown at an accelerated rate, with various purposes to what it is now and will continue to expand.

3. SYSTEM MODELLING

This chapter gives the block diagram description, functions of each block in this system.

3.1 Block diagram of ROV Underwater Drone:

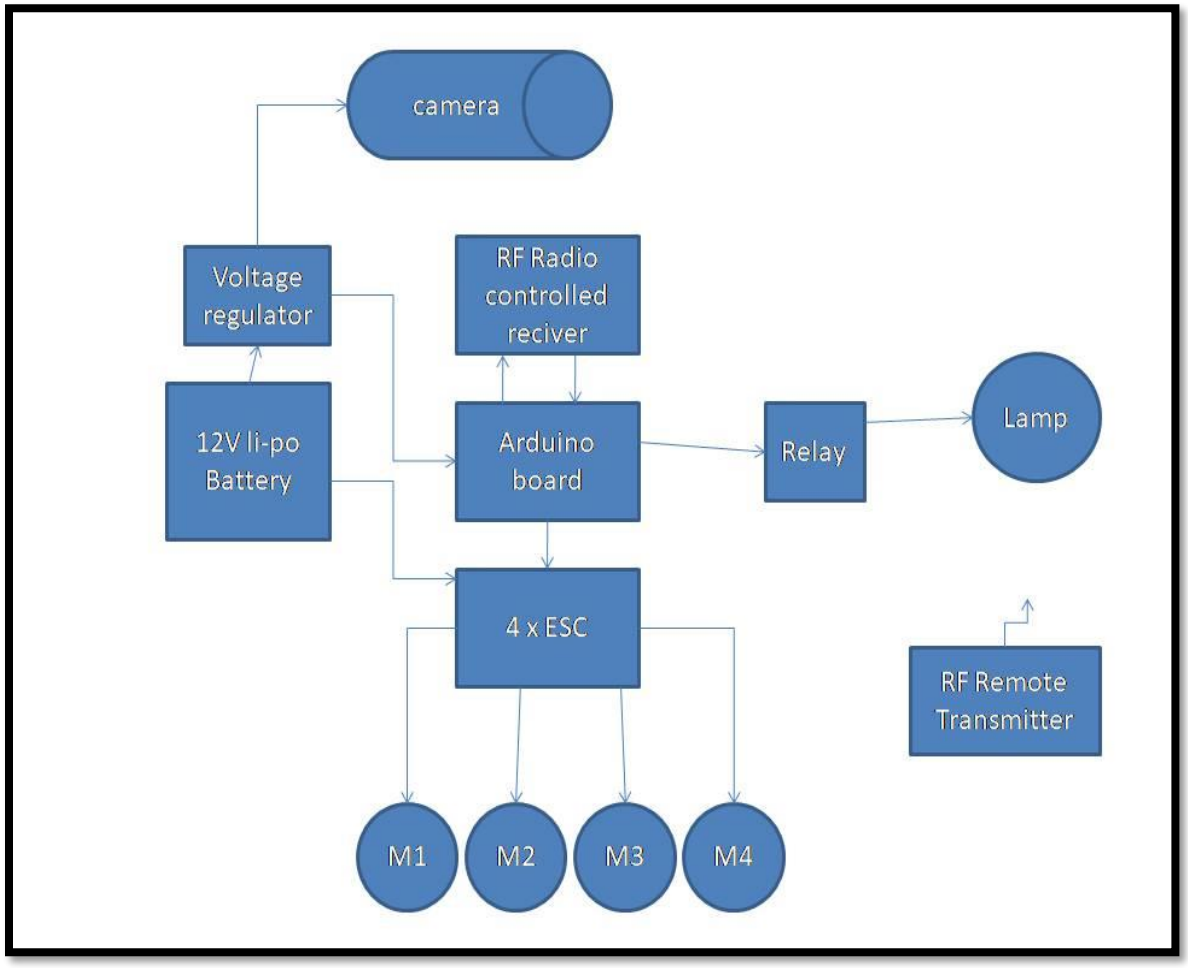

Fig.3.1 Block Diagram of ROV Underwater Drone

3.1.1 Block Diagram Description:

The Block Diagram presented in fig 3.1 is the diagram of ROV Underwater Drone.

The central unit Arduino is the main component of the system. By the Arduino board the whole system is control. These drones work as miniature submarines without crew. The underwater drone works by controlling its buoyancy so that it doesn't sink. Like all underwater vehicles,

they have crush depths and can be designed for different operating conditions. The motors they used push water and allow the drone to move about either by command or on their own. The cameras in the drone act like eyes, allowing the operators to guide the drone to its target. The drone transmitter is an electronic device that uses radio signals to transmit commands wirelessly via a set radio frequency over to the Radio Receiver, which id connected to the drone being remoted controlled. Yaw rotates the drone clockwise or counterclockwise allowing you to make circles or patterns in the air. Throttle Controls the amount of power sent to your drone which makes the drone go faster or slower. Voltage regulator that the maintains the output voltage of an electrical power system constant, regardless of changes in the load current or input voltage. Voltage regulator is used to control one or more AC or DC voltages depending on the design. The drones camera requires significant illumination to capture quality, high resolution images, and videos. At night drone-mounted lights or terrestrial scene lights are keys to get quality footage. Drones lights open up the possibilities for how you can use your drone at night or in the dark.

3.2 Functions of each block

- **Arduino Board:** Arduino is a great way to detect a leak spill, flood, rain, etc. It can be used to detect the presence, the level the volume or the absence of water. The sensors has an array to exposed traces, which read low when water is detected. The data collected by the sensors must be transmitted to buoy floating on the surfaces.
- **12V Lipo-Battery:** The battery provides higher specific energy other than lithium battery types and are used for the drones because they offer the advantages of high energy density in relation to the size and weight, with a higher voltage per cell, so they can power the drones on-boards system with fewer cell than other rechargeable. They are small and can carry a lot of charge in one cell (3.7v to 4.2v).
- **Voltage Regulator:** The voltage regulator maintains the output voltage of an electric power system constant, regardless of the changes in the load current or input voltage. It keeps the voltage from a power supply within a range that is compatible with the other electrical components.
- **RF Controlled Receiver:** The receiver on the drone is an electronic device that uses built in antennas to receive radio signal from the drone controller. But the receiver

doesn't receive signals from the drone controller. It also interprets the signals and convert them into alternating current pulses.

- **RF Controlled Transmitter:** A drone radio transmitter is an electronic device that uses radio signal to transmit commands wirelessly via set radio frequency over to the radio receiver which is connected to the drone being remotely controlled.
- **40A ESC:** The 40A ESC (Electric Speed Control) is a great little powerful ESC that runs the very well and doesn't run hot like other ESC. It allows the drone controllers to control and adjust the speed of the electric motors. A signal from a drone controller causes the ESC to raise or lower the voltage to the motors as required, thus changing the speed of the propellers.
- **Motors:** The most common use of motors for drones and in ROV'S is to spin the propellers of multirotor drones to enable them to rotate under the water. 1000kv DC motor for drone is a motor specially made for quadcopters and multirotor. It provides high performance, super power and brilliant efficiency. These motors are perfect for medium size quadcopters with 8 inch to 10 inch propellers.
- **Relay:** A relay is an electrically operated switch and like any other switch, it that can be turned on or off, letting the current go through or not. It can be controlled with low voltages like the 3.3w provided by Arduino and allows us to control high voltages like 12V. the relay module used to drive the motors and supports the propellers to rotate.

- **Camera:** The ROV cameras any visual imaging system that can be used on underwater ROVs to provide the operator with a perception of the operating environment. The depth rating for an ROV camera usually starts at 300m. Most ROVs have the forward facing camera for the control of the devices.

4. DEVELOPMENT OF THE SYSTEM

This chapter include the block-wise design consideration of each block, software and hardware included choice of components.

4.1 HARDWARE DESCRIPTION

4.1.1 Arduino board

Generally, development boards like Arduino and Raspberry pi are common choices when Prototyping new devices. Those development boards are essentially mini computers that can connect to and reprogram by standard PC. After it has been programmed that development board can be connected to and control sensors in the field. In that internet that development board requires need a way to connect to the internet, in this which field the best way to connect to the internet is by using wireless network.

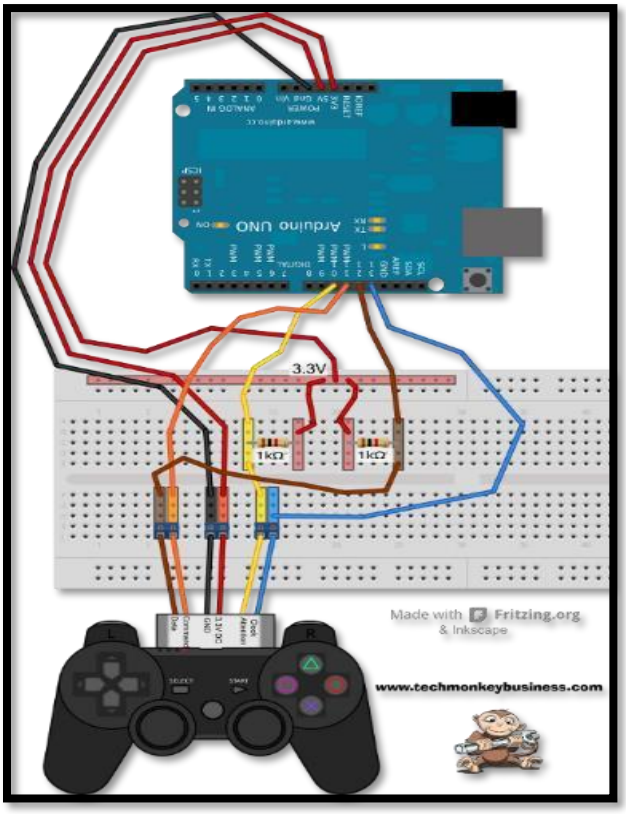

Fig. 4.1 Wiring Diagram of the Arduino board Setup

Arduino is a great way to detect a leak spill, flood, rain, etc. It can be used to detect the presence, the level the volume or the absence of water. The sensors have an array to exposed traces, which read low when water is detected. The data collected by the sensors must be transmitted to buoy floating on the surfaces. The chassis of the ROV was fashioned from a series of 50mm PVC tubes that vary in size from 70mm all the way up to 450mm in length. A rectangular base act as a skid and helps prevent rough landings from injuring the robot. Above that is a small box which houses a 12V lead-acid battery, along with the electronics. Commands are sent from the surface control box via UART to the Arduino Nano within the ROV, which in turn activates a bank of relay modules that turns on both the vertical and horizontal thrusters for planar movements.

4.1.2 12V Lipo Batteries

. The most common batteries used in drones are lithium polymer (LiPo) batteries. LiPo batteries are composed of a lithium-based cathode and anode separated by a polymer electrolyte.

The voltage rating of the battery will allow you to determine your motor speed and amperage. Since motors are rated in Kv with the unit RPM/Volt, the number of volts your battery can supply will determine how fast your motor will spin.

The battery provides higher specific energy other than lithium battery types and are used for the drones because they offer the advantages of high energy density in relation to the size and weight, with a higher voltage per cell, so they can power the drones on-boards system with fewer cell than other rechargeable. They are small and can carry a lot of charge in one cell.

Fig. 4.2 12v Lipo battery

4.1.3 Voltage Regulator

The voltage regulator maintains the output voltage of an electric power system constant, regardless of the changes in the load current or input voltage. It keeps the voltage from a power supply within a range that is compatible with the other electrical components.

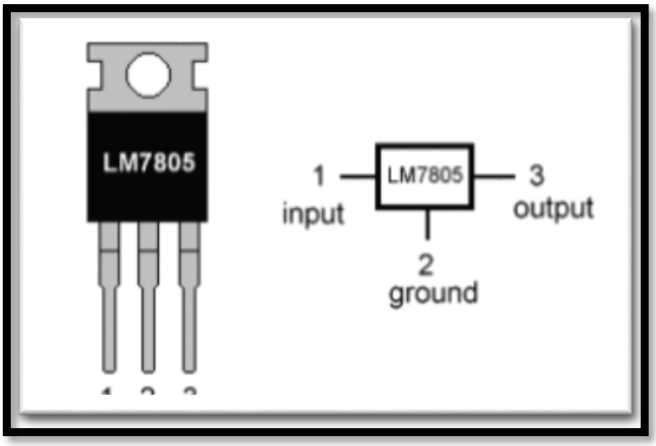

Fig. 4.3 Voltage Regulator

A voltage regulator is an electronic circuit that provides a stable dc voltage independent of the load current, temperature and ac line voltage variations. Voltage sources in a circuit may have fluctuations resulting in not giving fixed voltage outputs. Voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a voltage regulator integrated circuit (IC) is a member of 78xx series of fixed linear voltage regulator ICs used to maintain such fluctuations. The xx in 78xx indicates the fixed output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add heat sink as well.

4.1.4 RF Radio Controlled Transmitter/Receiver

4.1.4.1 RF Radio Controlled Transmitter

The transmitter is an electronic device that uses the radio signals to transmit commands wirelessly via a set radio frequency over to the Radio Receiver, which is connected to an aircraft or multirotor being remotely controlled. In other words, it's the device that translate pilots commands into movement of the multirotor.

Your drone transmitter will read your stick inputs and send them through the air to your receiver in near real time. Once the receiver has this information it passes it on to your drone controller which make the drone move accordingly. Hence it is important to pick the right transmitter.

4.1.4.2 RF Radio Controlled Receiver

A radio receiver is a device capable of receiving commands from a radio transmitter, interpreting the signals through the flight controller where these commands are translated into specific actions to control the underwater drone

- Telemetry (sending data back to transmitter)
- Redundancy function (two receivers connected, if one losses connection, second on e takes over)
- Easily removable antennas (more convenient with connectors if antenna is to be replaced)
- Possibility of firmware upgrades (for bug fixes)

The receiver must be compatible with the radio transmitter which in most cases means that the same brand of RX and TX must be purchased to establish communication. However, there are radio receivers that can work with the same protocol but not the same on RX and TX. For example, 2.4 GHz transmitter can only work with the 2.4GHz radio receiver.

Fig. 4.4 RF Radio Transmitter and Receiver

Specifications of CT6B

Channel	6
Model Type	Fixed-wing/glider/heli
RF Range	2.4055-2.475GHz
Band	140
RX Sensitivity	-105dBm
2.4G System	AFHDS
Code Type	GFSK
ANT Length	26mm
Weight	13g
Power	4.0-6.5v
Size	45*23*9mm
Color	Grey (Transparent)

4.1.5 40A ESC

The 40A ESC (Electric Speed Control) is a great little powerful ESC that runs the very well and doesn't run hot like other ESC. It allows the drone controllers to control and adjust the speed of the electric motors. A signal from a drone controller causes the ESC to raise or lower the

voltage to the motors as required, thus changing the speed of the propellers.

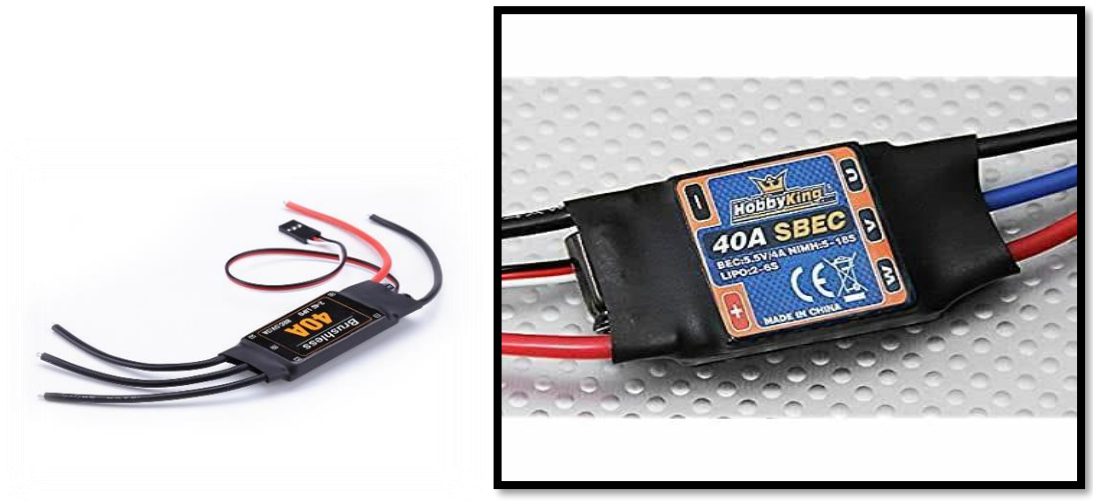

Fig. 4.5 40A ESC (electric speed control)

40A 2-4S ESC is specifically made for quadcopters and multi-rotors. Which provides faster and better motor speed control giving better flight performance compared to other available ESCs. ReadytoSky 40A 2-4S ESC comes with a multi-integrated special program, fast throttle response, surpasses all kinds of open-source software. Firmware was optimized specifically integrated circuitously for the disc motor, and it has very good compatibility and this ESC is compatible with 2-4s Lipo Battery.

The throttle signal line is twisted wire to reduce crosstalk within the transmission signal generated by the copper, so that more stable flight. This ESC Supports refresh rates of up to 621Hz. Due to ultra-low resistance MOSFET, it has a strong flow capacity. With MOSFET special driver integrated circuit, its performance and stability far surpass the driving circuit with discrete components built compatible with various flight controllers.

4.1.6 Motors/propellers

The most common use of motors for drones and in ROV'S is to spin the propellers of multirotor drones to enable them to rotate under the water. 1000kv brushless DC motor for drone is a motor

specially made for quadcopters and multirotor. It provides high performance, super power and brilliant efficiency. These motors are perfect for medium size quadcopters with 8 inch to 10 inch propellers.

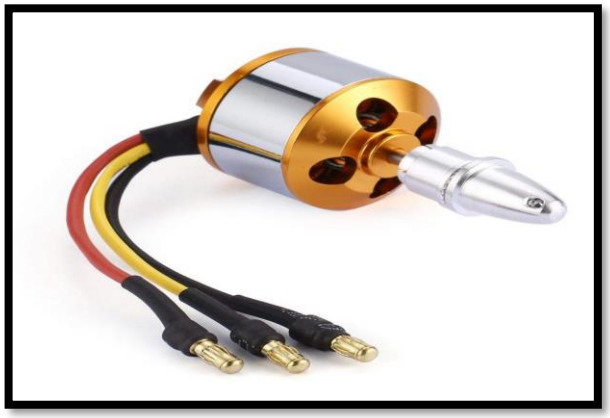

Fig. 4.6 1000kv motor

Fig. 4.7 Propellers

4.1.7 Relays

A relay is an electrically operated switch and like any other switch, it that can be turned on or off, letting the current go through or not. It can be controlled with low voltages like the 3.3w

provided by Arduino and allows us to control high voltages like 12V. the relay module used to drive the motors and supports the propellers to rotate.

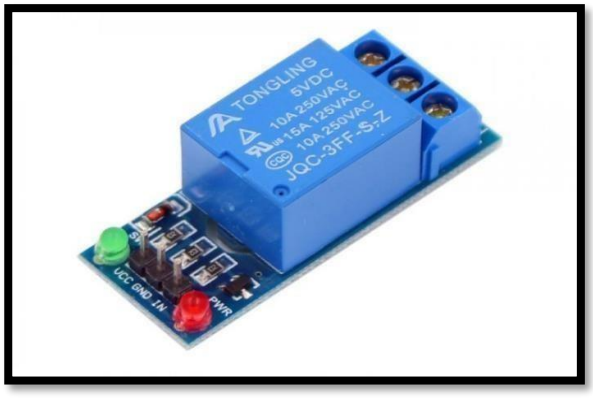

Fig. 4.8 Relay

The relay module is an electrical switch. It isolates the input side from the output side. When it reads input, it uses an electro-magnet to turn the switch on or off. Its output side has three pins – COM (Power Supply), NC (Normally Closed), NO (Normally Open). NO and NC has the load (in this case an LED is being used). If high input is given through the input side, NO pin will go LOW and NC pin will go HIGH. Here, in the proposed system NO (Normally Open) pin of the relay is connected to the LED. The relay module (9V) is used to drive the motor and propellers.

4.1.8Cameras

The ROV cameras any visual imaging system that can be used on underwater ROVs to provide the operator with a perception of the operating environment. The depth rating for an ROV camera usually starts at 300m. Most ROVs have the forward facing camera for the control of the devices.

As ROV is considers replacing the divers of deep water, the camera will function as a pair of eyes of human. Instead, the camera can be used to record the data in the shape of pictures and videos. Instead of recording, the camera is also important as a safety to the ROV.

Fig. 4.9 Wifi Based Camera

5. PERFORMANCE ANALYSIS

The performance analysis of the ROV Underwater Surveillance Drone.

Following are the photographs of the system.

Case 1: The developed system.

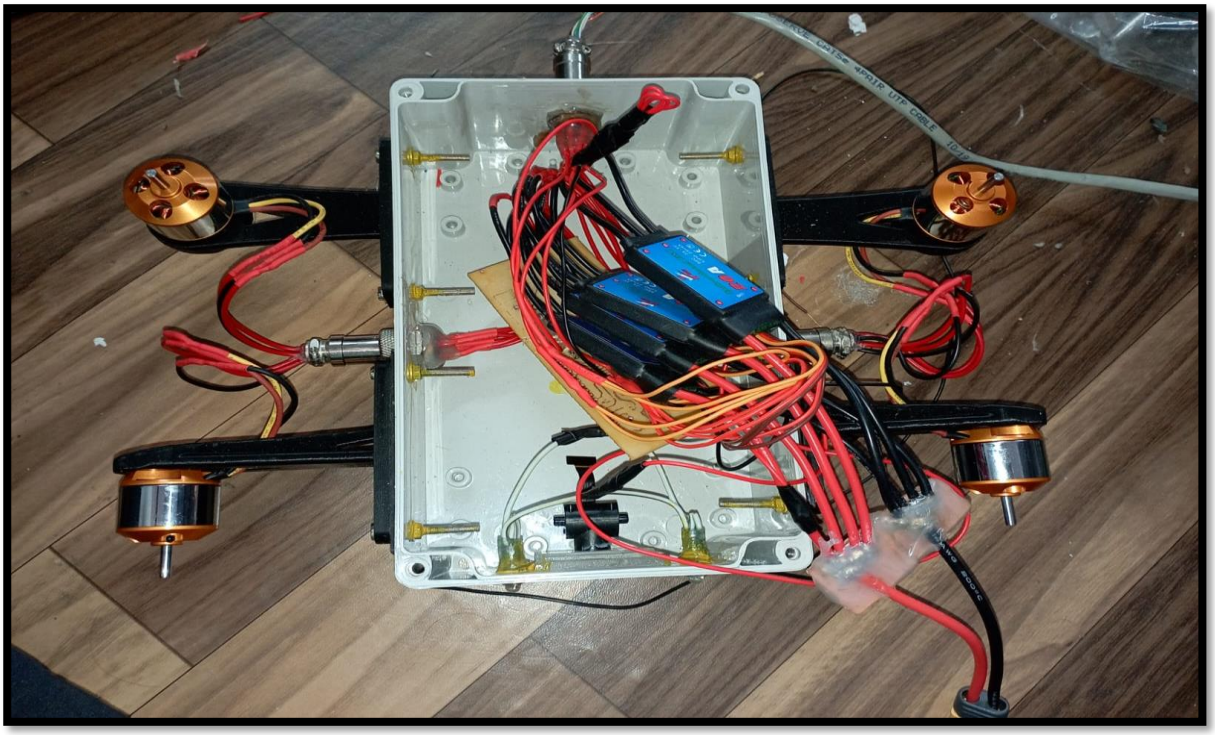

Fig. 5.1 The developed System

Case 2: Wi-Fi based camera.

Fig. 5.2 Developed WiFi based camera.

Case 3: Rotating Motors

Fig. 5.3 Rotating Motors

Case 4: Final developed underwater drone image.

Fig. 5.4 Final developed underwater drone image.

6.SUMMARY AND CONCLUSION

6.1 Advantages:

1. Underwater drones are equipped with high resolution cameras and sophisticated imaging sensors that allow them detailed images of bodies of water. This make it easier to monitor water quality, observe aquatic life.
2. Drones are capable of collecting large amount of data quickly and efficiently. This data can be used to create detailed map of aquatic environments, track aquatic life and identify areas of concern.
3. They can be used to monitor the conditions of dams and reservoirs, measure water level and inspect underwater equipment.
4. Underwater drones can be used to monitor the health and safety of the fish and other aquatic life.
5. Drones are used to detect pollutants keep eye on fish health and monitor the health of aquatic plants.
6. They provide high- quality visuals, collect valuable data, aid in maintenance and repair task.
7. These drones have the ability to navigate the waters and collect the data from the depths of the ocean.

6.2 Disadvantages

1 Depth of the range limited by length of cable. Equipment's needs a hard boat to operate. May be unable to access very shallow waters.

2 A major disadvantage of using ROVs for deployment of the sensor is that the tether which is generally 500-1000m long, limits the aerial coverage.

6.3Applications

1. ROVs are used when diving is impractical and dangerous for humans while working or investigating submerged hazards in the deep water. ROVs carry video cameras, lights, and robotic arms to grab things. ROVs help humans safely study the ocean by going to places where humans cannot go.

2.ROVs are used prolifically across a number of industries for observation, inspection, and intervention tasks. Here are the main industries that use these systems along with a list of their main commercial applications.

FUTURE SCOPE

Remotely Operated Vehicles (ROVs) are underwater drones that are remotely controlled from a surface vessel. They are used for a variety of applications, including underwater inspection, repair, and maintenance, as well as scientific research.

ROVs have become an essential tool in the offshore oil and gas industry, as they allow for the inspection and maintenance of underwater structures and pipelines without the need for divers.

They are also commonly used in the oceanographic and scientific research communities for underwater mapping and data collection.

ROVs range in size from small, handheld units to large, heavy-duty vehicles that can carry out complex tasks in deep-water environments.

The use of ROVs has increased in recent years due to the growth of the offshore energy sector and the increasing demand for underwater inspection and maintenance services.

ROVs are equipped with a variety of sensors, cameras, and manipulator arms to carry out a range of tasks, such as collecting samples, performing inspections, and installing equipment.

The increasing adoption of ROVs is also driven by advancements in technology, such as the development of more powerful and efficient underwater propulsion systems, improved cameras, and better control systems.

The global ROV market is expected to continue growing, driven by the increasing demand for underwater inspection, repair, and maintenance services in the offshore energy sector, as well as the growing demand for underwater data collection and mapping.

CONCLUSION

Wrapping up all the information available, the project of Remotely Operated Vehicle (ROV) is sure can be scaled down into a smaller size and the scope of function can be expanded into the education, security and fishing industry. For the propulsion system, bilge pumps made of DC motor and propeller can be used. A CCTV security camera or webcam can be installed at the prototype as its eyes, and the ROV frame is designed by using material of the PVC pipes. To help the CCTV gaining clear visions, the lightings system consists of two 12 volts DC bulbs with a light dimmer circuit is applied.

The project objectives of studying and analysis the ROV development as well as developing the electrical system configuration (simulation) for the prototype are achieved. Besides, the optimal design for the ROV can also be achieved giving many tests should be done to the ROV prototype when its construction is finished.

The designs of the prototype can be modified according to its application. When the prototype is built, more underwater test should be done and to rectify any error. Additional studies, especially on the CCTV camera functions, the propulsion, buoyancy in term of balancing the weight, and control unit system are needed. Enhancement can also be made to the lighting system where waterproof torch light can be used to avoid the vaporization inside the lamp and also to simplify the task of waterproofing them.

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