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Dual Survival

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Abstract: The purpose of the dual survival is to have a complete surveillance in air as well as in water within a single system. About many years a great research is going on unmanned aerial vehicle (UAV) and autonomous underwater vehicle (AUV) to improve the technology embedded it. We have focused our aim towards designing a drone which can do both the works of UAV and AUV. For this purpose we have took Quad as our basic outer skull design. To design such a system, first we have undergone a series of demonstration with the same electronics and avionics theory installed in a quadcopter to check whether this working principle can be embedded in underwater drones. Besides many failures we have achieved a conclusion that the principle used in quadcopters can be utilized in driving the drone beneath the water. Having this all design principles and calculations we have extracted an idea for an design of amphibian drone.

I. INTRODUCTION

Recently many scientists and researchers are working on UAV and AUV separately and they are more successful in their research works. Keeping these two works in our mind we are about to design a drone which can do both the functions of UAV and AUV that is it can fly in air as well float, sink under water bodies respectively. Before looking into our design in detail first we have to know what is unmanned aerial vehicle and autonomous underwater vehicle.

A. Unmanned Aerial Vehicle

Unmanned aerial vehicle is an aircraft without a human pilot aboard. The flight of UAVs may operate with various degrees of autonomy. Either under remote control by a human operator or fully autonomously, by onboard computers. Compared to manned aircraft UAVs care often preferred for missions too "dull, dirty or dangerous" for humans. They originated mostly in military applications although their use is expanding in commercial, scientific, recreational, agricultural, and other applications such as policing and surveillance, product deliveries, aerial photography, agriculture and drone racing.

B. Autonomous Under Water Vehicle

An autonomous underwater vehicle (AUV) is a robot that travels underwater without requiring input from an operator. AUVs constitute part of a larger group of undersea systems known as unmanned underwater vehicle, a classification that includes non-autonomous remotely operated underwater vehicles (ROVs) controlled and powered from the surface by an operator/pilot via an umbilical or using remote control. In military applications AUV is more often referred to simply as unmanned undersea vehicle (UUV). Underwater gliders are a subclass of AUVs.

C. Quadcopter

A Quadcopter, also called a Quad rotor helicopter is a multirotor helicopter that is lifted and propelled by four rotors. Quadcopters are classified as rotorcraft as opposed to fixed-wing aircraft because their lift is generated by a set of rotors (vertically oriented propellers). Quadcopters generally use two pairs of identical fixed pitched propellers two clockwise (CW) and two counterclockwise (CCW). These use independent variation of the speed of each rotor to achieve control. By changing the speed of each rotor it is possible to specifically generate a desired total thrust to locate for the center of thrust both laterally and longitudinally and to create a desired total torque or turning force.

II. LITERATURE SURVEY

1) UAV for 3D mapping applications Unmanned aerial vehicle (UAV) platforms are a valuable source of data for inspection, surveillance, mapping, and 3D modelling issues. As UAVs can be considered as a low-cost alternative to the classical manned aerial photogrammetric, new applications in the short- and close-range domain are introduced. Rotary or fixed-wing UAVs, capable of performing the photogrammetric data acquisition with amateur or SLR digital cameras, can fly in manual, semi-automated, and autonomous modes. Following a typical photogrammetric workflow, 3D results like digital surface or terrain models, contours, textured 3D models, vector information, etc. Can be produced, even on large areas.

2) Survey of Motion Planning Literature in the Presence of Uncertainty Provides a survey of motion planning techniques under uncertainty with a focus on their application to autonomous guidance of unmanned aerial vehicles (UAVs). The paper first describes the primary sources of uncertainty arising in UAV guidance and then describes relevant practical techniques that have been reported in the literature. The paper makes a point of distinguishing between contributions from the field of robotics and artificial intelligence, and the field of dynamical systems and controls. Mutual and individual contributions for these fields are highlighted providing a roadmap for tackling the UAV guidance problem.
3) Design of an adaptive nonlinear controller for depth control of an autonomous underwater vehicle This paper presents an adaptive nonlinear controller for diving control of an autonomous underwater vehicle (AUV). So far, diving dynamics of an AUV has often been derived under various assumptions on the motion of the vehicle. Typically, the pitch angle of AUV has been assumed to be small in the diving plane. However, these kinds of assumptions may induce large modeling errors and further may cause severe problems in many practical applications. In this paper, through a certain simple modification, we break the above restricting condition on the vehicle's pitch angle in diving motion so that the vehicle could take free pitch motion. Proposed adaptive nonlinear controller is designed by using a traditional back stepping method. Finally, certain numerical studies are presented to illustrate the effectiveness of proposed control scheme, and some practical features of the control law are also discussed.
4) A low-cost autonomous underwater vehicle combining glider and AUV capabilities The paper describes the current developments of a class of low-cost, lightweight autonomous underwater vehicles for coastal oceanographic applications the vehicle class is named Fòlaga, the Italian name of an aquatic bird that swims on the water surface and dives to catch fish. The main design characteristics of the most recent vehicle of the class, the Fòlaga III, are reviewed. Navigation and control system design are discussed, with particular attention to the diving phase, which is accomplished as in oceanographic gliders by varying the vehicle buoyancy and attitude. Experimental results show that the PID robust controllers implemented are effective in the diving control phase. Finally, a distributed cooperation algorithm to be applied by a team of Fòlaga-like vehicles in adaptive oceanographic sampling applications is described. The algorithm optimizes area coverage while taking into account the accuracy in the reconstruction of the oceanographic field and inter-vehicle communication through a range constraint. The resulting dynamic programming algorithm can be implemented in a distributed fashion among the team components.
5) UAV and AUVs coordination for ocean exploration They develop a coordination mechanism for multiple Autonomous underwater vehicles (AUVs) and a single Unmanned aerial vehicle (UAV) cooperatively performing a ocean exploration mission. The UAV and the AUVs have limited sensor and communication constraints. The AUVs are deployed in the ocean and surface when their mission leg is completed. The UAV flies over the AUV, acquires the information procured by the AUV and generates a new mission plan to the AUV. The UAV has to meet all the AUVs and reach the base station within a prescribed sortie time. However, the AUVs may not complete the assigned task and may surface anywhere along the current mission leg. Hence, the UAV has to take the uncertainty of AUV surfacing into account while it generates the next mission plan to the AUV otherwise it may not satisfy the sortie time constraint. We develop a robust mechanism of determining the route for the UAV and path generation for the AUV such that the UAV always reaches the base station within the sortie time limit. Theoretical results are presented to show the robustness of the algorithms. Simulations are carried out to show how the mission is accomplished.

III. DESIGN OF DUAL SURVIVAL

A. Design Modelling.

We have used modeling software's such as CATIA V5, Solid works for design of our model. Major of the parts were designed in CATIA V5 as user-friendly software. All the dimensions are in millimeter (mm) the exploded view and dimensional views are as follows

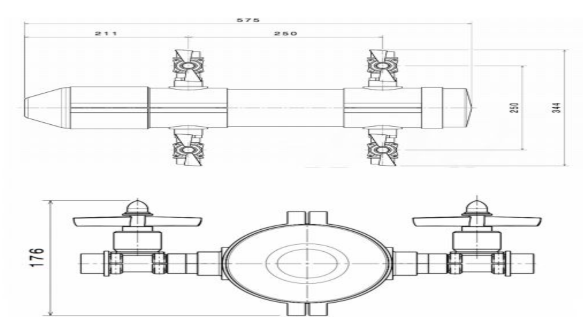


Figure 1. Dimensional view of Dual Survival

The above shown views show a sample model of our drone which was specially designed to know that the electronics and structures used for aerial drones can accommodate with water or not. Autonomous underwater vehicle is an unmanned drone which can float as well as swim under water. There are various types of such drones in different shapes and sizes. The shape and sizes are distinct mainly due to their cause and purposes.

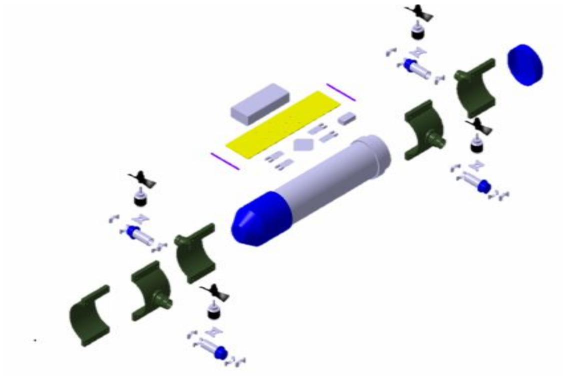
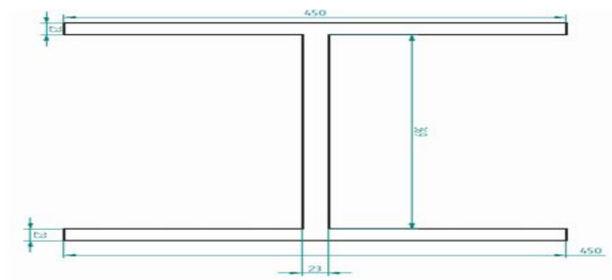


Figure 2. Exploded view of Dual Survival

The autonomous underwater vehicle consists of different types of sensors, electronic instruments, autopilot system and much more instruments to get a stable drive.

B. Dimensional View Of Dual Survival



PARTS	DIAMENSIONS
FLANGE	LENGHT-450 mm
	DIA-23mm
WEB	LENGTH-415mm
	DIA-23mm
PROPELLER	LENGTH-355.6mm(14inch)
	ANGLE OF TWIST (β)-5.5°
AEROFOIL	NACA0019
MOTOR	LENGTH-55mm
	INNER DIA-36mm
	OUTER DIA-55mm
CONTROL BOARD	LENGTH-240mm
LANDING SKID	LENGTH-253mm

C. Determination of C.G

Basically design calculation consists determination of center of gravity, weight, payload and other design parameters with will improve the performance of the drone.

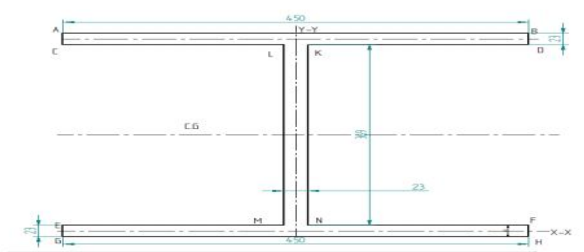


Figure 3. Determination of cg for Dual Survival

a1= Area of rectangle ABCD= 450×23 = 10350mm2
Y1 = Dist. of rectangle ABCD from bottom GH
= 23+369+(23/2) = 403.5mm
a2= Area of rectangle KLMN= 369×23 = 8487mm2
Y2 = Distance of COG of rectangle KLMN from bottom line ML= (415/2) = 207.5mm
$\bar{y}$ = (a1Y1+a2Y2+a3Y3)/A
=[(10350×403.5)+(8487×207.5)+(10350×11.5)]÷(10350 +8487+10350)
$\bar{y}$ = 147.46 mm

D. Determination of Weight

The overall weight of dual survival is 2.15kg approx. It consists of four motors mounted on each side on I structure. Each motor consists of power of 750KV and it can have a payload weight of up to 5kg approximately.

IV. FABRICATION

The fabrication of dual survival consists of different types of electronic circuits, structures, components and materials, which can sustain maximum amount of loads in air as well as water medium. As we were successful in experimenting the electronics used for air medium were very suitable in water medium also. The fabrication includes: Materials used ,Structure ,Components.

A. Material used in Fabrication.

Carbon fiber reinforced polymer, carbon fiber reinforced plastic or carbon fiber reinforced thermoplastic (CFRP, CRP, CFRTP or often simply carbon fiber, or even carbon), is an extremely strong and light fiber-reinforced plastic which contains carbon fiber. (The spelling 'fiber' is common in British Commonwealth countries) CFRPs can be expensive to produce but are commonly used wherever high strength-to-weight ratio and rigidity are required, such as aerospace, automotive, civil engineering, sports goods and an increasing number of other consumer and technical applications. The binding polymer is often a thermoset resin such as epoxy, but other thermoset or thermoplastic polymers, such as polyester, vinyl ester or nylon, are sometimes used.
The composite may contain other fiber, such as an aramid (e.g. Kevlar, Twaron), aluminum, ultra-high-molecular-weight polyethylene (UHMWPE) or glass fiber, as well as carbon fiber. The properties of the final CFRP product can also be affected by the type of additives introduced to the binding matrix (the resin). The most frequent additive is silica, but other additives such as rubber and carbon nanotubes can be used. The material is also referred to as graphite-reinforced polymer or graphite fibre-reinforced polymer (GFRP is less common, as it clashes with glass-(fiber)-reinforced polymer). In product advertisements, it is sometimes referred to simply as graphite fiber for short.

B. Structure

An I-beam, also known as h-beam, w-beam (for "wide flange"), universal beam (UB), rolled steeljoist (RSI), or double-t (especially in polish, Bulgarian, Spanish, Italian and German), is a beam with an I or H-shaped cross-section. The horizontal elements of the "I" are known as flanges, while the vertical element is termed the "web". I-beams are usually made of structural steel and are used in construction and civil engineering.

Figure 4. “I” beam drone

I-beams may be used both on their own, or acting compositely with another material, typically concrete. Design may be governed by any of the following criteria

1) *Deflection:* the stiffness of the I-beam will be chosen to minimize deformation
2) *Vibration:* the stiffness and mass are chosen to prevent unacceptable vibrations, particularly in settings sensitive to vibrations, such as offices and libraries.
3) *Bending failure by yielding:* where the stress in the cross section exceeds the yield stress
4) *Bending failure by lateral torsion buckling:* where a flange in compression tends to buckle sideways or the entire cross-section buckles torsional.
5) *Bending failure by local buckling:* where the flange or web is so slender as to buckle locally

6) *Local yield:* caused by concentrated loads, such as at the beam's point of support.
7) *Shear failure where the web fails.* Slender webs will fail by buckling, rippling in a phenomenon termed tension field action, but shear failure is also resisted by the stiffness of the flanges.
8) *Buckling or yielding of components:* for example, of stiffeners used to provide stability to the I beam's web.

As the above listed criteria exists in every I-structure. We use I-structure as our outer skull to have a good maneuvering stability in air as well as water. The flanges sections at their ends consists brushless motors to which propellers are fixed to produce lift. As the drone drops in water from the air it produces an immense load on the structure of the quad. To overcome the breakage of the body structure due to the transition load that occurs between air and water we have used I-structure as our design of the skull.

C. Components Used

We use different types of components and parts for the fabrication of dual survival namely;

1) Propeller
2) Brushless motor
3) Electrical speed controller
4) Flight controller
5) Gyroscope
6) Accelerometer
7) Barometer
8) Global positioning system
9) Atmega644p
10) Battery
11) Transmitter
12) Receiver

V. WORKING PRINCIPLE

The system uses a set of three angles to describe, in this case, the orientation of the multirotor around the three special dimensions. They are called roll, pitch and yaw.

To describe the orientation of the quadcopter, we use three angles roll, pitch, and yaw.

1) The roll angle of the multirotor describes how the craft is tilted side to side. Rotation about the roll axis is like tilting your head towards one of your shoulders. Rolling the multirotor causes it to move sideways.
2) The pitch angle of the multirotor describes how the craft is tilted forwards or backwards. Rotation about the pitch axis is like tilting your head in order to look up or down. Pitching the multirotor causes it to move forwards or backwards.
3) The yaw angle of the multirotor describes its bearing or in other words rotation of the craft as it stays level to the ground. Rotation about the yaw axis is like when you shake your head to say "no"
4) There is one final bit of terminology we will use to discuss flying the multirotor, and that is throttle. Throttle simply controls the altitude of the multirotor.

A. Steering

While flying your multirotor, it is very important to understand how the multirotor moves and how we control it. At the root of all the multirotor movements is the rotational speed of the motors. By adjusting the relative speeds of the motors in just the right ways, keeping in mind that the rotational speed of the motors determines how much lift each prop produces, the flight controller is able to cause the multirotor to rotate around any of the directional axes (roll, pitch, and yaw), or make the multirotor gain or lose altitude.

B. Hovering

A dual survival works on principle of vertical takeoff and landing (VTOL).To make the multirotor hover, which means the multi-rotor stays at a constant altitude without rotating in any direction, a balance of forces is needed. The flight controller will need to counteract the force the gravity with the lift produce by the rotor. The lift produce by the multi-rotor is equal to the sum of the lift produce by each of its rotors.

Therefore the force of gravity equal to the force of the lift produce by the motors, thus the multi-rotor will maintain the constant altitude. The flight controller disrupts the balance to ascend or descend. If the lift produce by the multi-rotor is greater than the force of gravity, the quad will gain altitude.

C. Lateral and Longitudanal control

Along the lateral axis rolling motion occurs rolling of a dual survival is done as same as that of other drone principles. To roll at right the motors mounted of right hand side (RHS) remains constant speed whereas the speed of motors at lift hand side (LHS) increases. To roll at left the motors mounted on left hand side remains constant speed whereas the speed of motors at right hand side increases. The below shown figure gives the clear picture of lateral control.

The primary control motion is achieved by varying the rpm produced by the brushless motor. The forward pitch motion is achieved by increasing the rpm of rear motor and maintaining constant rpm of front motors this will make the system to pitch forward. To pitch backward the speed of the front motors increases and in turn maintaining constant rpm of the rear motor. This provides a backward thrust and tends the drone to pitch backward. The below shown figure gives the clear picture of longitudinal control.

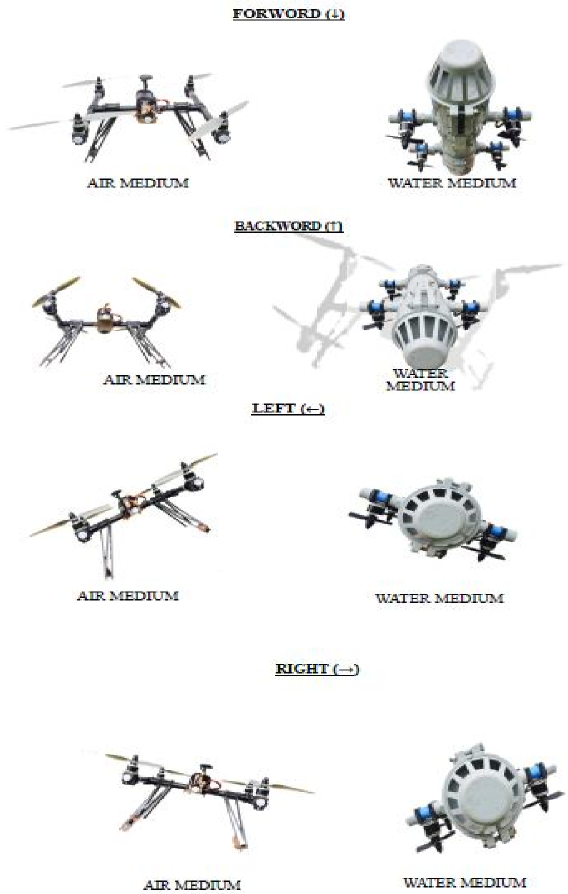


Figure 5. Lateral and longitudanal control of Dual survival

D. Directionalcontrol

The yawing motion is done along the directional axis. In this case the speed of the diagonally mounted motors speed are varied .To yaw towards the left position (anticlockwise) the rpm of diagonally mounted motors of right position are varied. To yaw towards right,(clockwise) the rpm of motors mounted on left side diagonally are varied. The below shown figure gives the clear picture of directional control.

Figure 6. Directional control of Dual Survival Communication

Most UAVs use a radio frequency front-end that connects the antenna to the analog-to-digital converter and a flight computer that controls avionics (and that may be capable of autonomous or semiautonomous operation).

Radio allows remote control and exchange of video and other data. Early UAVs had only uplink. Downlinks (e.g., real-time video) came later. In military systems and high-end domestic applications, downlink may convey payload management status. In civilian applications, most transmissions are commands from operator to vehicle. Downstream is mainly video. Telemetry is another kind of downstream link, transmitting status about the aircraft systems to the remote operator. UAVs use also satellite "uplink" to access satellite navigation systems.

The radio signal from the operator side can be issued from either

1) Ground control – a human operating a radio transmitter/receiver, a smartphone, a tablet, a computer, or the original meaning of a military ground control station (GCS). Recently control from wearable devices, human movement recognition, human brain waveswas also demonstrated

2) Remote network system, such as satellite duplex data links for some military powers. Downstream digital video over mobile networks has also entered consumer markets, while direct UAV control uplink over the cellular mesh is under researched.

3) Another aircraft, serving as a relay or mobile control station – military manned-unmanned teaming (MUM-T)

E. Autonomy

A number of precautions should be followed to prevent injury or loss of the UAV. The main safety issue is that loss of signal, glitches or inadvertently moving a joystick could cause electric motors to turn on unexpectedly. For this reason, an UAV should always be handled as if the electric motors can turn on at any moment. When programming the transmitter, the propellers should be removed from the electric motors or the electric motors should be disconnected.

A common error mistake is to have the wrong aircraft profile loaded, causing some channels to be reversed, causing a crash. To prevent this, the direction of movement of all the channels should be checked before each flight.

Also, the transmitter should be 'range tested', by activating its range test mode, moving a distance away from the UAV, and confirming that the UAV can be controlled. This tests the range of transmission of the transmitter.

VI. DEVELOPEMENT CONSIDERATION

A. Endurance

UAV endurance is not constrained by the physiological capabilities of a human pilot. Because of their small size, low weight, low vibration and high power to weight ratio. Their engine rotors cannot seize, these attributes reduce fuel usage, increasing range or payload. Hydrogen fuel cells, using hydrogen power, may be able to extend the endurance of small UAVs, up to several hours. The maximum endurance that dual survival drone can give is 25 minutes in air medium and 18-20 minutes under water medium, by using a battery of 5000 mah capacity.

B. Range

It is a particular distance travelled by a drone by using one fully charged battery unit called as range. The battery used in dual survival is basically made up of lithium-polymer battery with a capacity of 5000 mah. It consists of 4 cells within it. The purpose of using lithium-polymer is due to high discharge rate, of 25C.

C. Reliability

Reliability improvements target all aspects of UAV systems, using resilience engineering and fault tolerance techniques. Individual reliability covers robustness of flight controllers, to ensure safety without excessive redundancy to minimize cost and weight. Besides, dynamic assessment of flight envelope allows damage-resilient UAVs, using non-linear analysis with ad-hoc designed loops or neural networks. UAV software liability is bending toward the design and certifications of manned avionics software

The study of drones in aerial system is totally different from that of water system. The pressure exerted on the drone in water is more as compared to that of air. It is approximately found that for 1meter of depth 10 bar of pressure is sensed in the pressure sensing unit used in autonomous under water vehicle.

VII. APPLICATIONS

This amphibian drone can be used for much number of tasks in airborne and underwater. With further development and using more advanced technology in this type of drone we can use it for more and more with tasks and missions are evolving constantly. The airborne drone can be used for,

1) Dual survival can be used in cinematography & data recording up to an altitude limit of 7km.

2) can be used in air surveillance monitoring system.

3) Monitoring the water bodies up to a depth of 5km.
4) The single system of dual survival can be used in both air medium & water medium.
5) Enemy tracing systems.
6) Target locating can be done with the help of dual survival.

REFERENCES

[1] Fabio remondino, UAV for 3D mapping applications. Published on 08 November .

[2] Navid Dadkhah: Survey of Motion Planning Literature in the Presence of Uncertainty, Published on 27 November 2011.

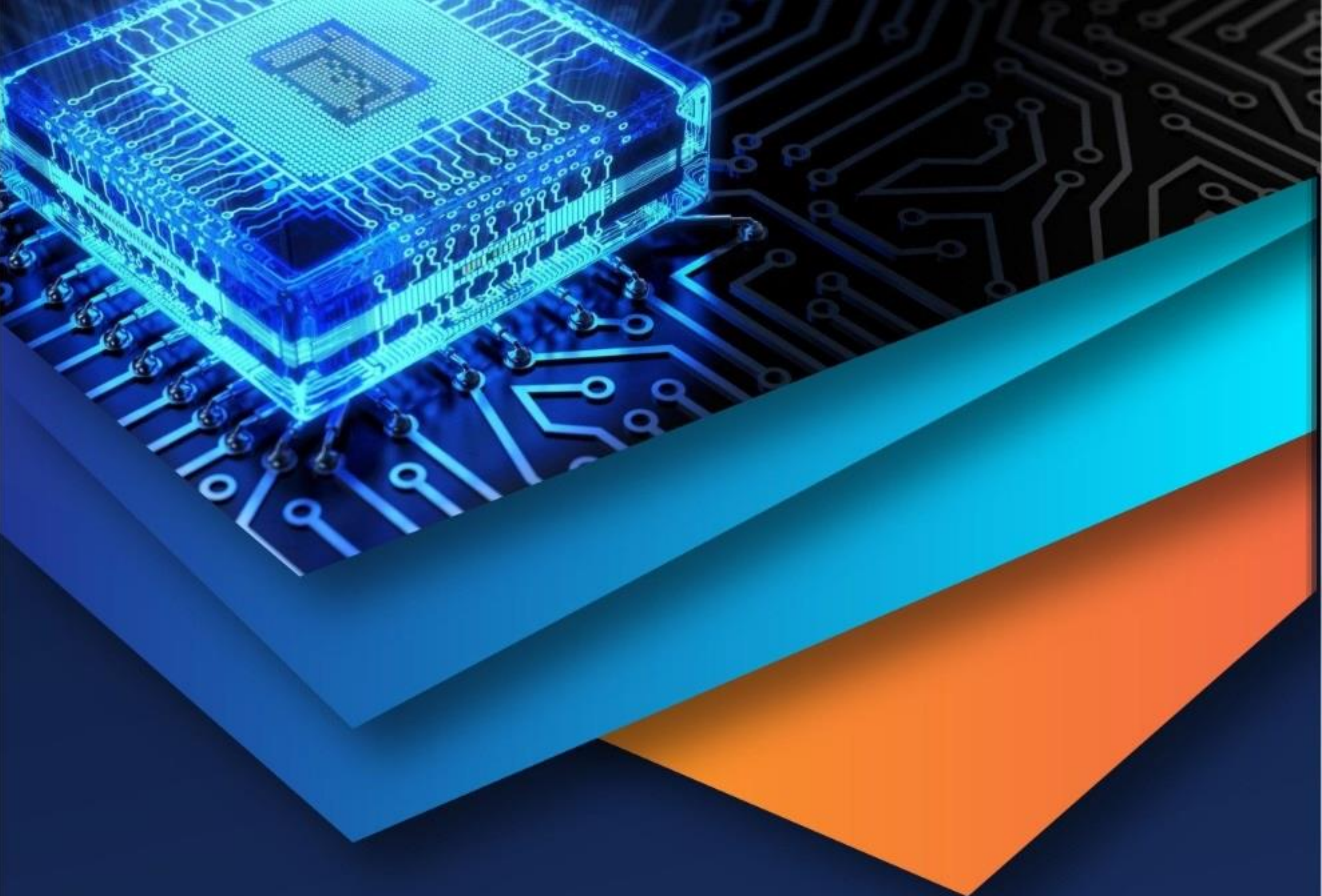
[3] JI-HONG LI: Design of an adaptive nonlinear controller for depth control of an autonomous underwater vehicle, Published-Volume 32, Issues 17–18, December 2005 .

[4] Alvarez: A low-cost autonomous underwater vehicle combining glider and AUV capabilities, Published-Volume 36, Issue 1, January 2009, PP. 24–38.

[5] P.B.SUJIT, JOAO SOUSE, F.L.PEREIRA (IEEE), UAV and auvs coordination for ocean exploration,Published in: OCEANS 2009 - EUROPE, DOI: 10.1109/OCEANSE.2009.5278262.

[6] AeroVironment's Global Observer Flying High, Again, April 06, 2011, Accessed October 27, 2012 from Defense Industry Daily.

[7] Singer, Peter. Drones The Global Swarm, Real Clear Politics, 13 March 2013 Accessed March 26.



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