BANNARI AMMAN INSTITUTE OF TECHNOLOGY

SATHYAMANGALAM-638401

TECHNICAL DOCUMENTATION

FOR

BIT-MAL-ROV

SUBMITTED BY

TEAM MENTORS:

KAMAL BASHA. K

TEAM HEAD:

PRASANTH.T

TEAM MEMBERS

VASANTH. S

MOOHANAKRISHNAN. K

KAMALESH. J

SRIVISHNU. S . S

CONTENTS:

1 INTRODUCTION:

1.1 ABSTRACT

BIT-MAL-ROV is an underwater vehicle designed to perform tasks without affecting the ecosystem. The underwater vehicle was designed and manufactured with low cost. It is tethered with controller using the tethered cable, we have used the basic control system to control the vehicle and a camera is placed in the vehicle which is connected to the monitor using the tether cable. The camera is programmed and connected through the Raspberry pi board. Our BIT-MAL-ROV is specifically manufactured to meet all the requirements of missions. The main frame of the ROV is made of PVC. The BIT-MAL-ROV consists of three thrusters. This BIT-MAL-ROV is not just a project, it is the inspiration by which we, young engineers, can learn and positively impact our environment.

1.2 TEAM STRUCTURE:

Our team consists of five students and a faculty. We all are from the mechanical engineering department. Kamal Basha K, is our team mentor Informed about the event and guided us throughout all the steps. The team involved in the process of designing, fabrication, software and also manoeuvring the vehicle.

2 TECHNICAL DETAILS:

2.1 BUOYANCY:

Buoyancy or up-thrust is an upward force exerted by a fluid that opposes the weight of a partially or fully immersed object. In a column of fluid, pressure increases with depth as a result of the weight of the overlying fluid. Thus, the pressure at the bottom of a column of fluid is greater than at the top of the column. Similarly, the pressure at the bottom of an object submerged in a fluid is greater than at the top of the object. The pressure difference results in a net upward force on the object. The magnitude of the force is proportional to the pressure difference, and is equivalent to the weight of the fluid that would otherwise occupy the submerged volume of the object, i.e., the displaced fluid. Buoyancy also applies to fluid mixtures, and is the most common driving force of convection currents. In these cases, the mathematical modeling is altered to apply to continua, but the principles remain the same. Examples of buoyancy driven flows include the spontaneous separation of air and water or oil and water. The center of buoyancy of an object is

the center of gravity of the displaced volume of fluid. Archimedes' principle is named after Archimedes of Syracuse, who first discovered this law in 212 BC. For objects, floating and sunken, and in gases as well as liquids Archimedes' principle may be stated thus in terms of forces:

Any object, wholly or partially immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object.

Buoyant force = Weight of displaced fluid

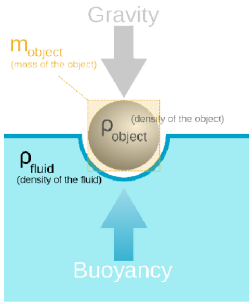


Fig 1 Buoyancy

2.2 STATIC STABILITY:

A floating object is stable if it tends to restore itself to an equilibrium position after a small displacement. For example, floating objects will generally have vertical stability, as if the object is pushed down slightly, this will create a greater buoyancy force, which, unbalanced by the weight force, will push the object back up.

Rotational stability is of great importance to floating vessels. Given a small angular displacement, the vessel may return to its original position (stable), move away from its original position (unstable), or remain where it is (neutral).

Rotational stability depends on the relative lines of action of forces on an object. The upward buoyancy force on an object acts through the center of buoyancy, being the centroid of the displaced volume of fluid. The weight force on the object acts through its center of gravity. A buoyant object will be stable if the center of gravity is beneath the center of buoyancy because any angular displacement will then produce a 'righting moment'.

The stability of a buoyant object at the surface is more complex, and it may remain stable even if the centre of gravity is above the centre of buoyancy, provided that when disturbed from the equilibrium position, the centre of buoyancy moves further to the same side that the centre of gravity moves, thus providing a positive righting moment. If this occurs, the floating object is said to have a positive metacenteric height. This situation is typically valid for a range of heel angles, beyond which the centre of buoyancy does not move enough to provide a positive righting moment, and the object becomes unstable. It is possible to shift from positive to negative or vice versa more than once during a heeling disturbance and many shapes are stable in more than one position.

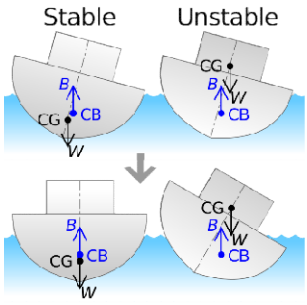


Fig 2 Stability

2.3 METACENTRIC HEIGHT (GM):

Metacentric height is a measurement of the initial static stability of a floating body. It is calculated as the distance between the Centre of gravity of a ship and its metacenter. A larger metacentric height implies greater initial stability against overturning.

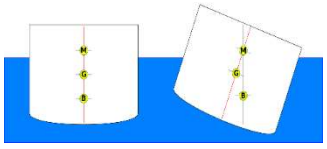


Fig 3 Metacentre

The centre of buoyancy is at the centre of mass of the volume of water that the hull displaces. This point is referred to as B in naval architecture. The centre of gravity of the ship is commonly denoted as point G or CG. When a ship is at equilibrium, the centre of buoyancy is vertically in line with the centre of gravity of the ship.

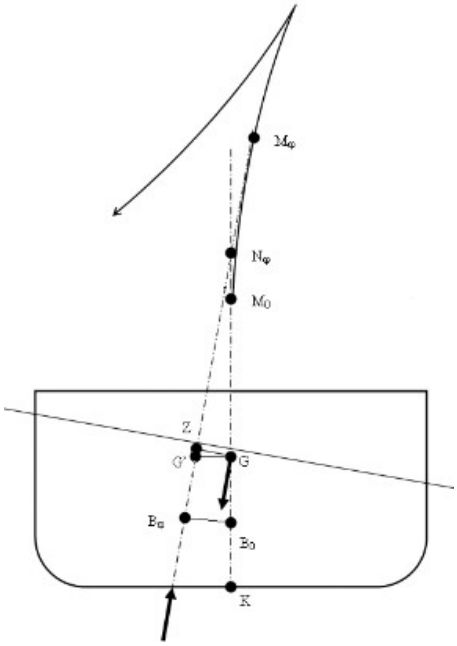


Fig 4 Different metacentre in body

3 SAFETIES:

We have made our vehicle in the eco-friendly manner to prevent it from polluting the water. Our vehicle made with the zero sharp edges and we have made the vehicle the vehicle to operate in the same medium of 12v dc supply. Our ROV is also 100% leak proof because the electrical circuits, controllers and battery components all are placed out of the vehicle and power and controls are transmitted through the cables. So, there is no chance of pollution of pool by the BIT-MAL-ROV.

4 SENSORS AND SOFTWARE USED:

4.1 Raspberry Pi

Raspberry Pi is a series of small single-board computers (SBCs) developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom. The Raspberry Pi project originally leaned towards the promotion of teaching basic computer science in schools and in developing countries. The original model became more popular than anticipated, selling outside its target market for uses such as robotics. It is widely used in many areas, such as

for weather monitoring. Because of its low cost, modularity, and open design. It is typically used by computer and electronic hobbyists, due to its adoption of HDMI and USB devices.

4.2 Python

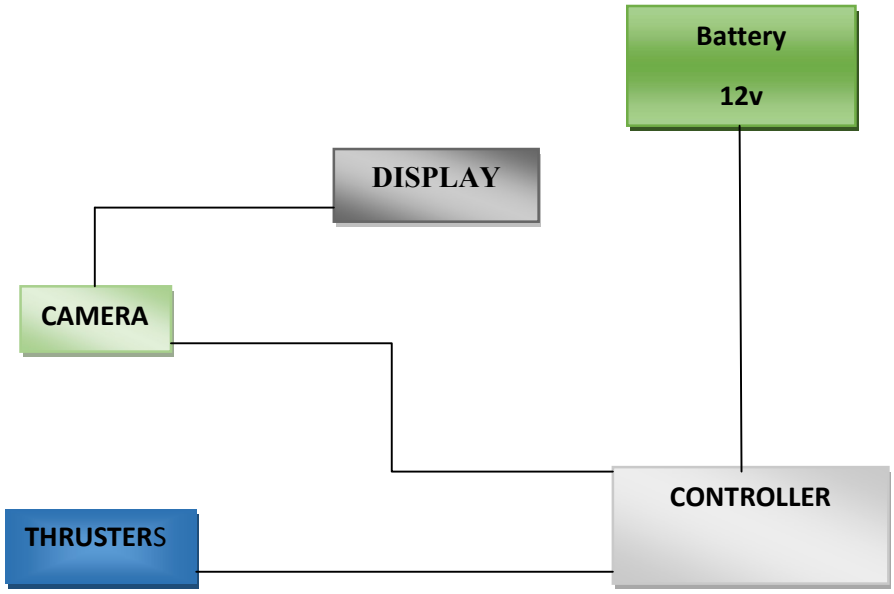
Python is an interpreted high-level general-purpose programming language. Its design philosophy emphasizes code readability with its use of significant indentation. Its language constructs as well as its object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects. It is a computer programming language which is used to program the raspberry pi which is the most important component for the camera configuration of the vehicle.

5 DESIGN:

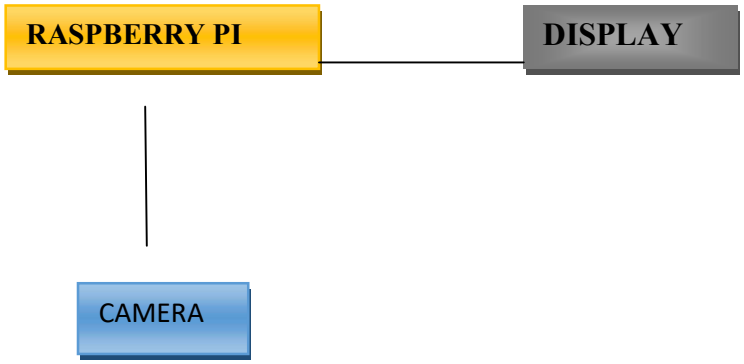
Our remotely operated vehicle is a very simple design which was created and modelled with the help of mentor and team members. Our ROV is designed and modelled using the SOLIDWORKS which is basic CAD software which is used for parts and assembly modelling. We used solid works to model our frame and structure of our vehicle. We used the simple PVC (poly vinyl chloride) pipes to reduce the complexity and weight of the vehicle. We have given the general description about our ROV.

Dimensions	: 470 x 400 x 280 mm
Mass of the ROV	: 4 kg
Number of thrusters	: 3 Nos
Power source adopter	: 12 V
Specification of the motor	: 12 V, 3 A, DC motor

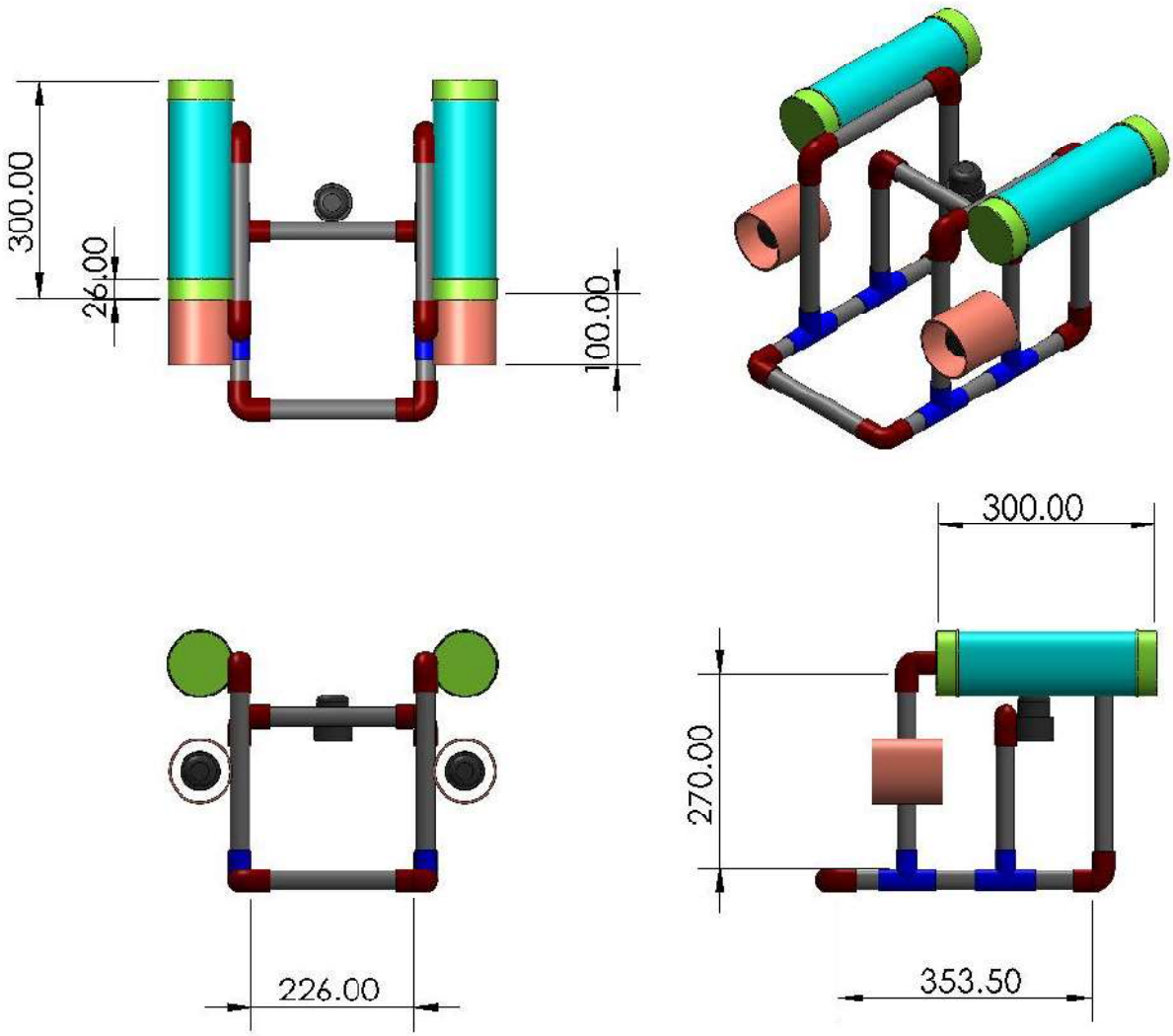
5.1 BLOCK DIAGRAM



CIRCUIT



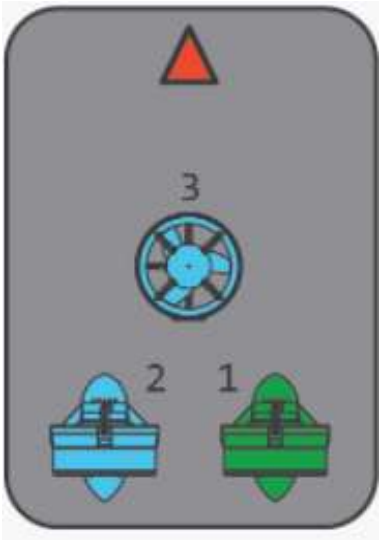
CAMERA CIRCUIT



DESIGN OF FRAME

5.2 THRUSTER:

For our ROV we have designed a new thruster which was made with the Seaflo 1100 GPH 12v Boat Marine Plumbing Electric Bilge Pump. We removed the pump casing and in the place of impeller we changed the propeller. We made an outer casing for the thruster using the 4" PVC pipes. The propeller blades are self designed by our team mates.



Configuration of Thrusters

5.3 SOFTWARES AND CONTROLLERS:

Raspberry Pi 3 Model B:

It was launched with a faster 1.4 GHz processor, a three-times faster gigabit Ethernet (throughput limited to ca. 300 Mbit/s by the internal USB 2.0 connection), and 2.4 / 5 GHz dual-band 802.11ac Wi-Fi (100 Mbit/s).[29] Other features are Power over Ethernet (PoE) (with the add-on PoE HAT), USB boot and network boot (an SD card is no longer required).

EAN	4200477657547
Item weight	140g
Manufacture series number	615
Model number	615
Number of items	1
Part number	615
Specification style met	Pi 3b

CAMERA:

We have used Logitech camera to see inside the water for the second and third task. It is the normal web cam which we have made water proof for our ROV.

Manufacturer	Logitech
Country	Vietnam
Series	C310
Color	Black
Height	31mm
Width	69mm
Product dimensions	71 x 31 x 69
Model number	C310
Power source	Yes
Included components	2.4 GHz Intel Core™ 2 Duo 2GB RAM 200 MB hard drive space USB 2.0 port 1 Mbps upload speed or higher 1280 x 720 screen resolution
Weight	250g

6. PROCUREMENT REPORT:

Sl. No.	Components	Quantity	Cost
1	PVC ¾ pipes	3 m	225.00
2	PVC Float pipe	0.75 m	275.00
3	Elbows	10 nos.	120.00
4	Tee joints	4 nos.	60.00
5	Raspberry pi	1 no.	3100.00
6	Camera	1 no.	2400.00
7	Propeller	3 nos.	3600.00
8	DC Motor	3 nos.	4200.00
9	Control switches	3 nos.	150.00
10	Wires	20 m	400.00

11	Fasters	As required	500.00
12	Battery 12v	1 no.	3000.00
	Total		**18030.00**