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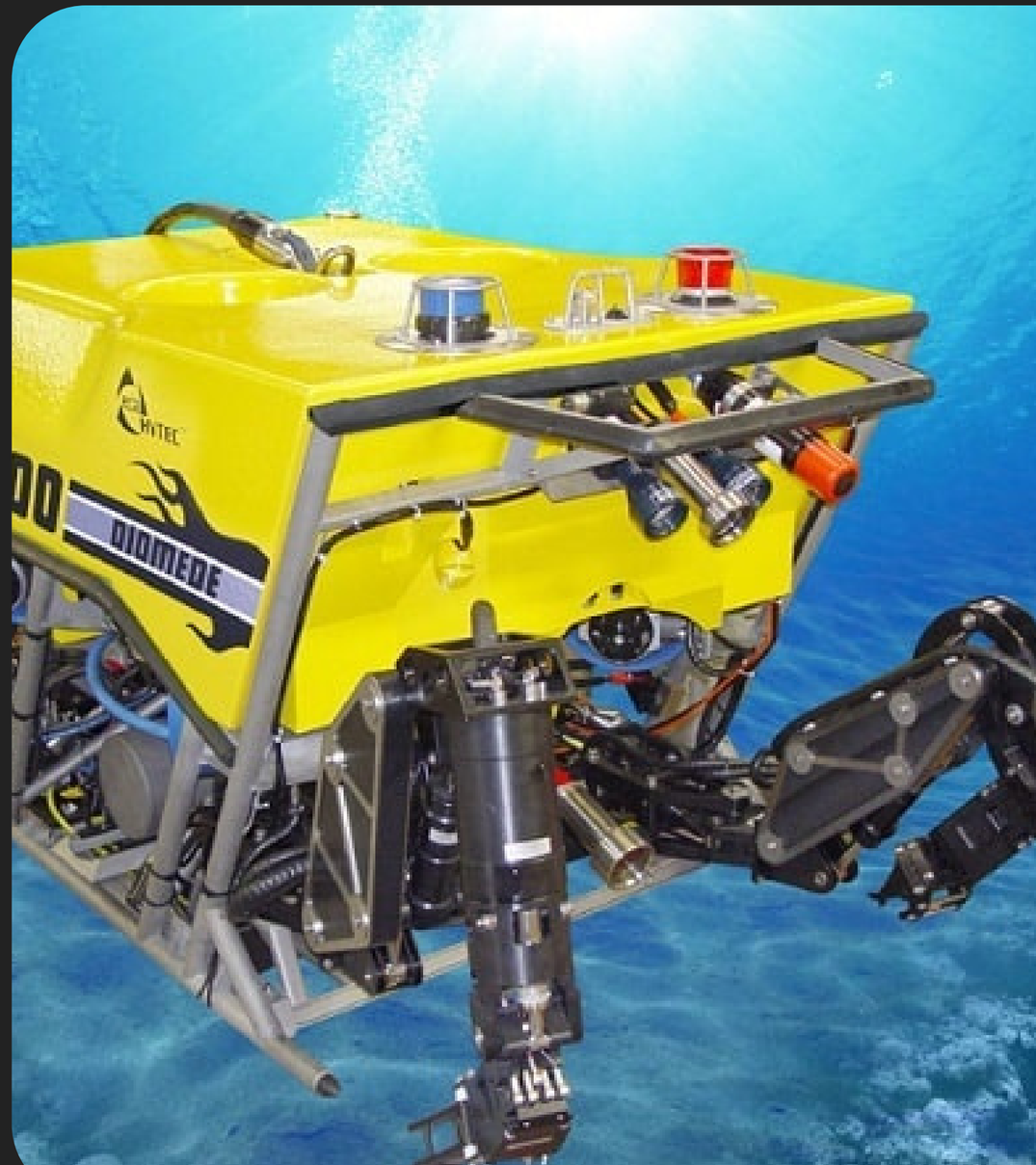
# ROBOTIC HARDWARE SYSTEM

# REMOTELY OPERATED VEHICLE (ROV)

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# REMOTELY OPERATED VEHICLE (ROV)



A REMOTELY OPERATED VEHICLE (ROV) IS AN UNOCCUPIED UNDERWATER ROBOT THAT IS CONNECTED TO A SHIP BY A SERIES OF CABLES. THESE CABLES TRANSMIT COMMAND AND CONTROL SIGNALS BETWEEN THE OPERATOR AND THE ROV, ALLOWING REMOTE NAVIGATION OF THE VEHICLE.

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# MAIN COMPONENTS

Presentation Outline

03

#1 Physical Design
#2 Propulsion System
#3 Navigation System (Sensors) & Control
#4 Data Collection
#5 Data transmission
#6 Power Management

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# Physical Design

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ROVs come in all shapes and sizes to address different needs, but they generally have some common elements.

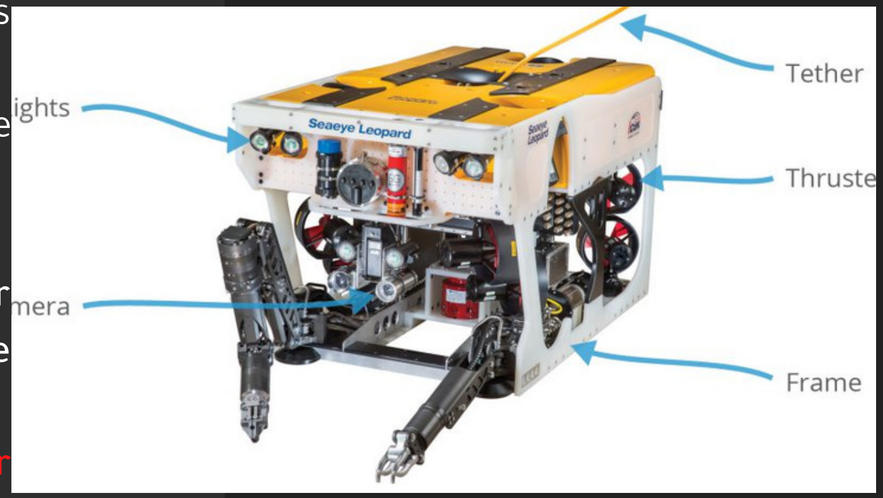
Thrusters: The thrusters are electrically or hydraulically powered propellers used to maneuver the vehicle.

Camera: Since the vehicle travels deep underwater, the only view that the pilot has is through the onboard camera

Lights: The lights provide illumination for the camera underwater.

Tether: Nearly all ROVs have a tether that carries electrical power and/or signals to the surface so that the pilot can control the vehicle and see the camera.

Frame: The frame of the ROV provides a firm platform for mounting, or attaching, the necessary mechanical, electrical, and propulsion components. This includes special tooling/instruments such as sonar, cameras, lighting, manipulator, scientific sensor, and sampling equipment. ROV frames have been made of materials ranging from plastic composites to aluminum tubing.



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# Physical Design

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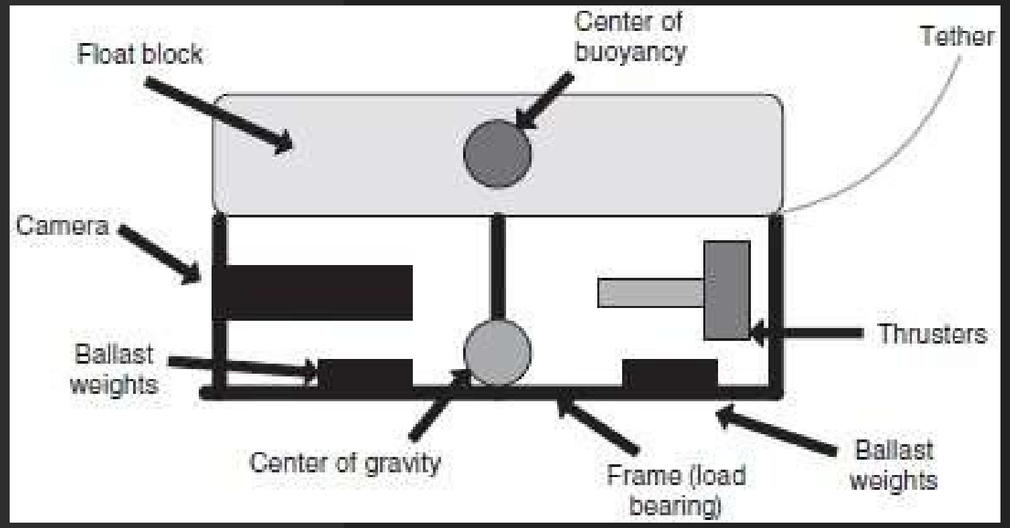
all components of an ROV system should be rated to the maximum operating depth of the underwater environment anticipated, including safety factors. However, they should not be over-designed.

As the operating depth proceeds into deeper water, larger component wall thicknesses will be required for the air-filled spaces (pressure-resistant housings) on the vehicle. This increased wall thickness results in an increased vehicle weight, which requires a larger floatation system to counter the additional weight. This causes an increase in drag due to a larger cross-section, which requires more power. More power drives the cable to become larger, which increases drag, etc. It quickly becomes a vicious design spiral.



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# LOCOMOTION SYSTEM AND ACTUATORS

The propulsion system significantly impacts the vehicle design. The type of thrusters, their configuration, and the power source to drive them usually take priority over many of the other components.

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# Propulsion systems

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ROV propulsion systems come in three different types: Electrical, hydraulic, and ducted jet propulsion. These different types have been developed to suit the size of vehicle and anticipated type of work. In some cases, the actual location of the work task has dictated the type of propulsion used.

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# Thruster basics

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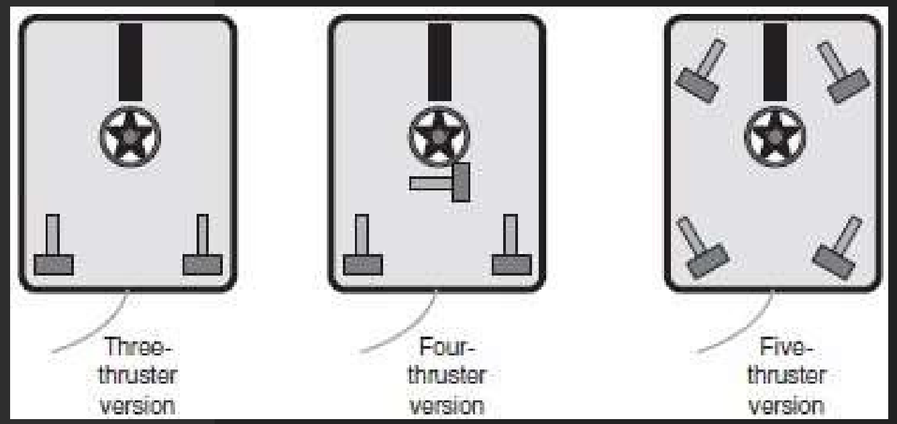
The ROV's propulsion system is made up of two or more thrusters that propel the vehicle in a manner that allows navigation to the work site. Thrusters must be positioned on the vehicle so that the moment arm of their thrust force, relative to the central mass of the vehicle, allows a proper amount of maneuverability and controllability.

The three-thruster arrangement (Figure) allows only fore/aft/yaw, while the fourth thruster also allows lateral translation. The five-thruster variation allows all four horizontal thrusters to thrust in any horizontal direction simultaneously.

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# Thruster design

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Underwater electrical thrusters are composed of the following major components:

- Power source
- Electric motor
- Motor controller (this may be part of the thruster or may be part of a separate driver board)
- Thruster housing and attachment to vehicle frame
- Gearing mechanism (if thruster is geared)
- Drive shafts, seals, and couplings
- Propeller
- Kort nozzle and stators

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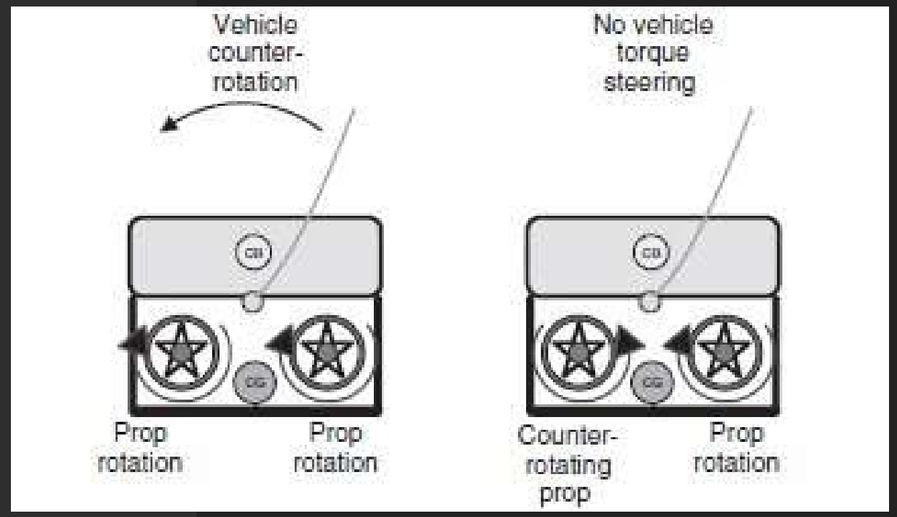

# Navigation System (Sensors) & Control

The classic control of ROVs is carried out by visual feedback. The operator sees the image transmitted from the cameras of the device via cable, that is often equipped with sonar sensors since the visibility in the research and work area is oftentimes poor and does not exceed 1-3 meters.
The most significant drawback in this approach is that most of the time it is impossible to locate the device just by looking at these images.

# Underwater Navigation



- applying hydroacoustic navigation system. As a rule either a pinger (a device that emits a special signal) or a responder-beacon are installed on the device. The bearings of pinger signal are taken, the distance is being determined, and then, based both on the signal arrival angle (or two angles – horizontal and vertical) and distance the location of the apparatus is being determined. These kind of systems are called SBL, short for short baseline systems. They are classified as AoA (angle of arrival) + TOF (time of flight) system and have a number of shortcomings, especially in relation to this task.

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# Underwater GPS



- RedNode System. The Navigation system consists of the actual navigation base, formed by four floating buoys transmitting GNSS signal


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# DATA TRANSMISSION AND COLLECTION



The remote operated vehicle system is divided and tested in two sub-systems: the ROV system (client) and the command unit (server) (Fig.2). The ROV is equipped by Arduino Mega card which acquire the date of GPS module, IMU sensors, WiFi module and control four motors. The motors are commanded by DC motor drivers. The command unit is a computer which has connect a joystick. This unit establish the acceleration an orientation of ROV and receive the sensors data for processing. For the data transmission between these two sub-system are tested different communication protocols, implemented on the microcontroller and computer. As the human machine interface are tested two intrfaces programmed in Processing and LabView software.

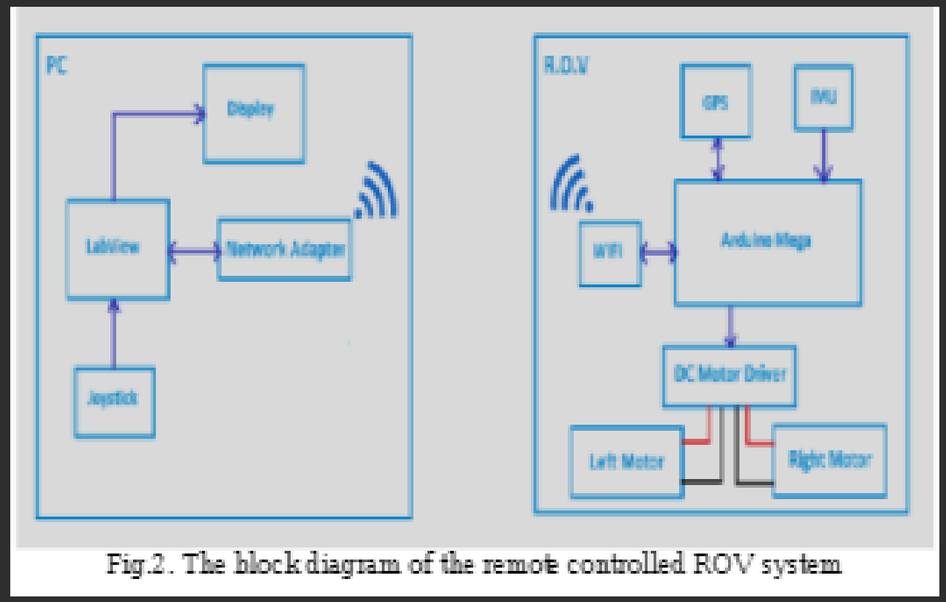


Fig.2. The block diagram of the remote controlled ROV system

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# Power Management



On a surface-powered ROV system, power arrives to the vehicle from a surface power source. The power can be in any form from basic shore power (e.g. 110 VAC 60 Hz or 220 VAC 50 Hz ” which is standard for most consumer electrical power delivery worldwide) to a DC battery source. The ROV components is powered from 7.2V and 2200mAh Lithium Polymer battery using a DC-DC converter which lowers the voltage to 6V (Fig.3). The Arduino pins can provide up to 40mA so we can power IMU and GPS modules directly from the 3.3V pins, but for the DC module .

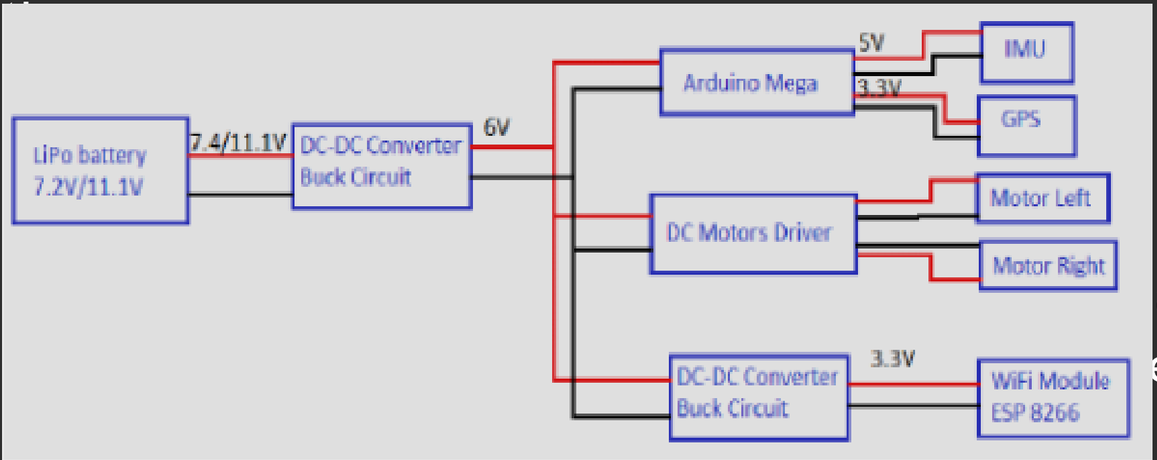


Fig.3. The power supply system forthe ROV

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