الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
Garden of Knowledge and Virtue

Remotely Operated Vehicle

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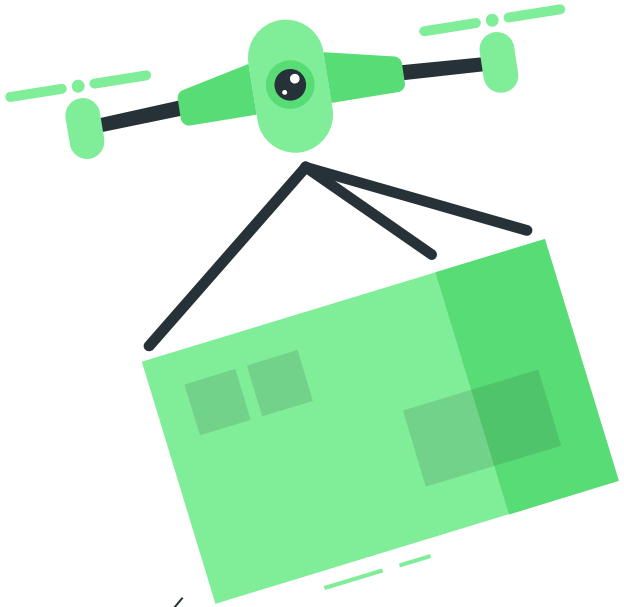
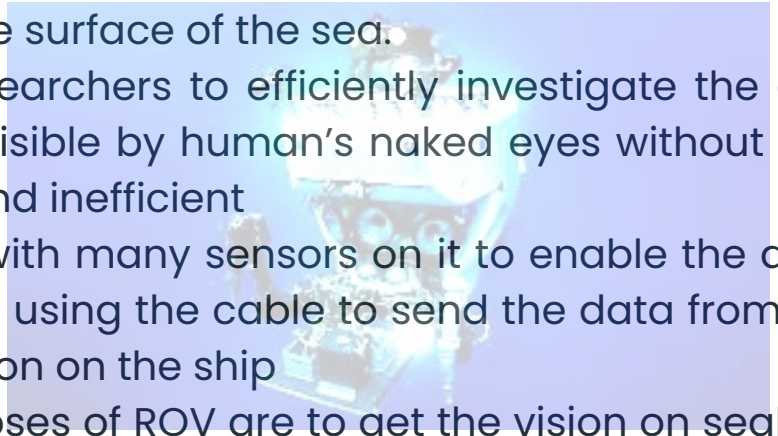
Introduction



What is R.O.V?

- Remotely operated vehicles, or "ROVs," are unmanned, nimble underwater vehicles that can be used to explore the depths of the ocean while being controlled from the surface of the sea.
- ROV allow the researchers to efficiently investigate the ocean depths and content that is invisible by human's naked eyes without diving into the sea that is very risky and inefficient
- ROV is equipped with many sensors on it to enable the data collection and usually connected using the cable to send the data from the underwater to the controller station on the ship
- Some of the purposes of ROV are to get the vision on seabed like finding the sank ship, collecting the seabed 's samples for the researchers about the marine biology and finding the potential mineral's location.

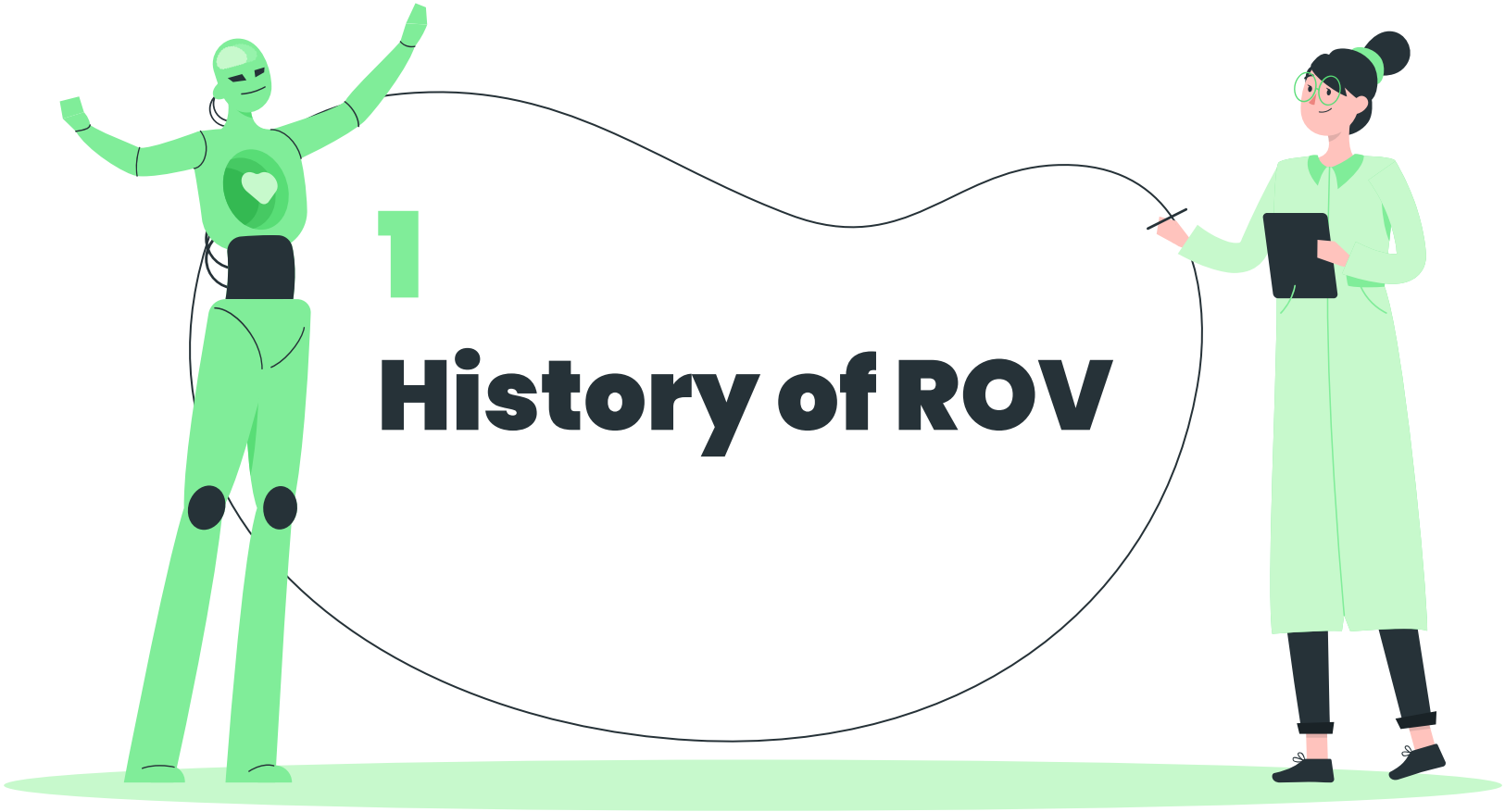


FUnction of ROV Today

- Research: ROVs are used by scientists to investigate the aquatic life and shipwrecks for underwater archaeological projects.
- Military and law enforcement: ROVs are utilised for environmental hazard detection, search and recovery operations, detonating explosives, and surveillance.
- Film and documentary: Filmmakers are now able to employ ROVs to capture footage for TV, cinema, and other broadcasting uses because to substantial advancements in ROV camera and lighting technology.
- Maritime: For ship hull and dock inspections, the maritime industry uses ROVs. ROVs enable vessel owners to find and quickly address structural issues with their vessels. Instead of sending a human diver, border security experts utilise ROVs to scan vessel hulls for illegal cargo since they are both safer and more effective.


FALKOR
GEORGE TOWN


DEEPOCEAN



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History of ROV

Year 1970, UK Royal Navy, Cutlet

- to recover practice torpedoes and mines
- Weight: 2,536 lbs, Depth: 1,148m,
- Propulsion system: Three 10 hp, reversible, electric thrusters
- Instrumentation: two CCTV cameras on p&t units, mag compass, depthometer, altimeter, torpedo locator, obstacle avoidance sonar, transponder, hydraulic manipulator with circular-type (torpedo grasping) claw

Year 1982, USA, Woods Hole Oceanographic Institute(WHOI), Cutlet

- to allow the scientist to explore the seafloor and collect the sample
- Weight: 4.5 tons, Depth: 6500 m, Payload: 50 kg
- Propulsion system: Six brushless DC thrusters each providing 250 lbf thrust
- Sensor: two-axis clinometer, 0.1 degree resolution, heading Flux-gate compass, 0.1 degree resolution, gimballed gyro, 0.1 degree resolution, pressure Depth Bulk semiconductor strain gauge, 1m resolution, Altitude 120kHz updating at 2Hz, 33 meters range, 0.1 m resolution

Main Component of ROV

Hull Design

1) Hull with open frame

Seaeye Falcon[19]

Enovus ROV[20]

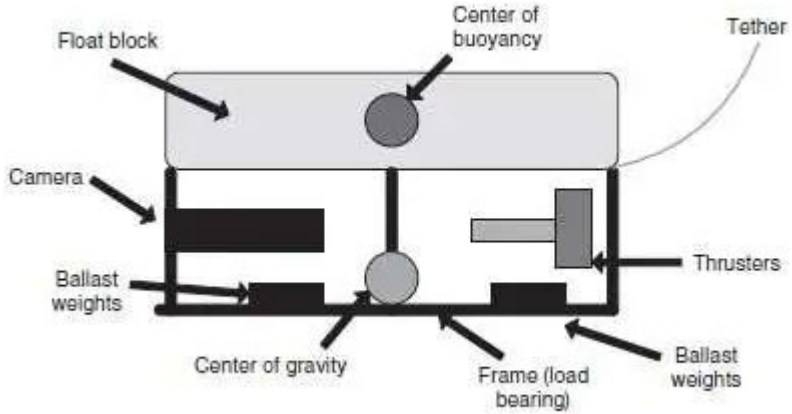
2) Frameless Hull (closed Hull)

SAAB Double Eagle SAROV[21]

Deep trekker DTG2[22]

Structure Type	Open Frame	Closed Frame
Advantages	• Stable 3 DOF translational motions based on large metacentre • Large payloads and can carry object • Easier to attach tools and equipments	• Greater mobility / highly maneuver • Lightweight and portable • Energy efficient
Disadvantages	• Have difficulties for motions more than 3 DOF	• Smaller payloads • Not convenient to attach tools and equipments

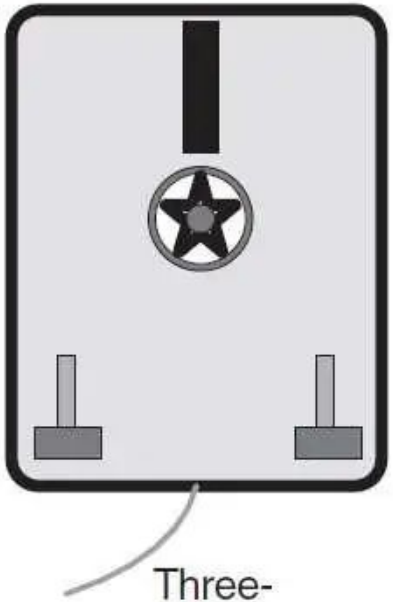
Propulsion System of ROV



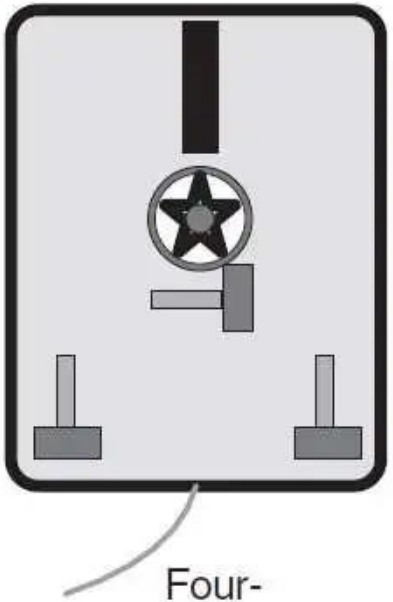
- The three different types of ROV propulsion systems are electrical, hydraulic, and ducted jet propulsion. These many sorts were created to accommodate the size of the vehicle and the anticipated nature of work. In several instances, the type of propulsion employed has been determined by the precise location of the job task.

- Ducted jet thruster systems might be employed, for instance, if the vehicle is operating near loosely packed debris that could be drawn into revolving thrusters. The vehicle could be operated with hydraulics if heavy-duty tooling is needed for intervention (including thruster power).

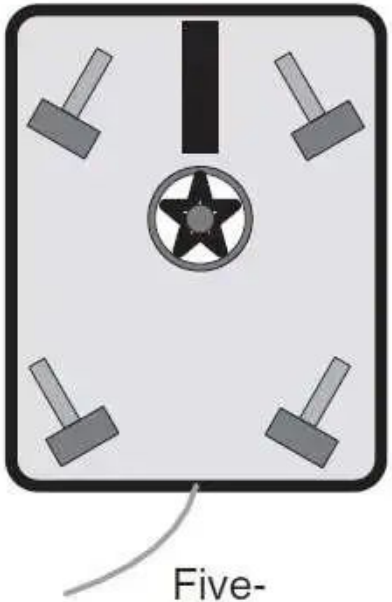
- An electrical motor on the vehicle is used to power hydraulic pump systems, which necessitates a conversion of energy from electrical to mechanical to hydraulic—a process that consumes a lot of energy. Such an energy loss and associated expenditures must be justified by a clear requirement for high mechanical force.



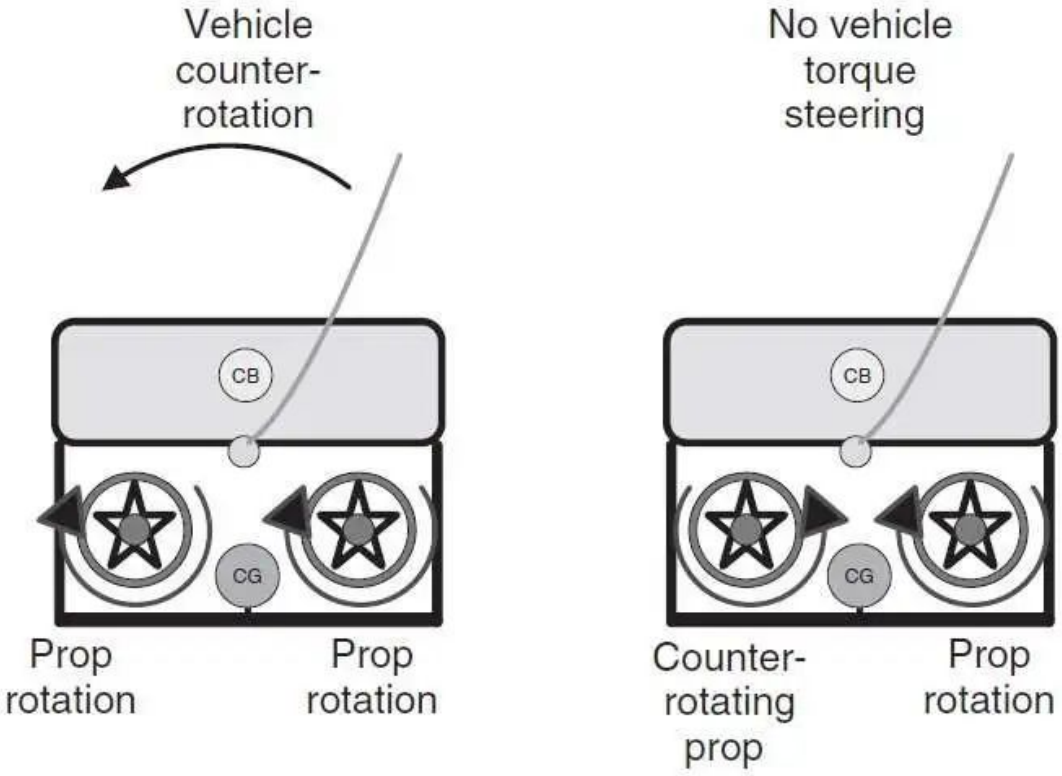
Three-thruster version



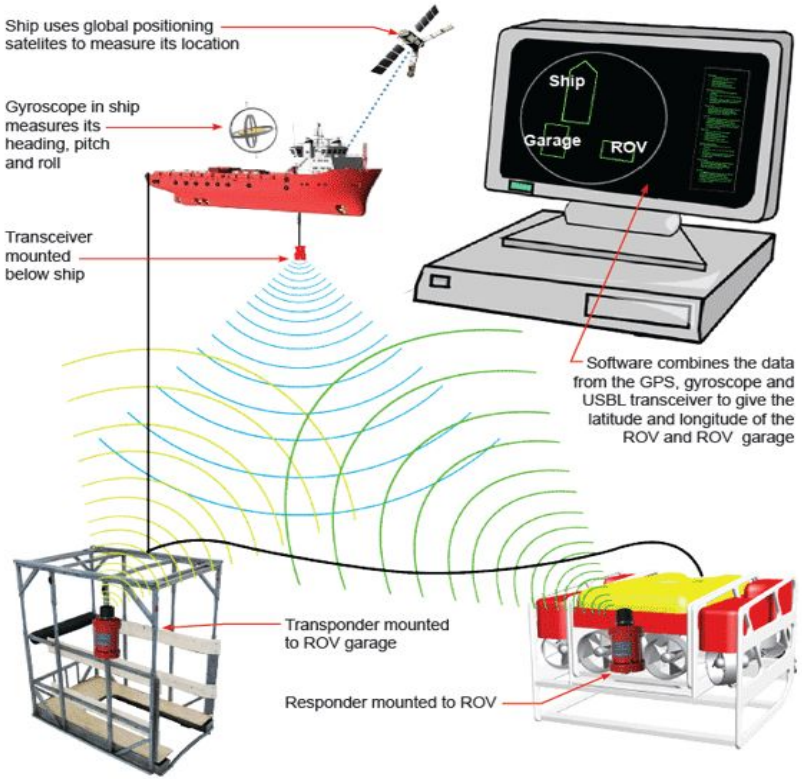
Four-thruster version



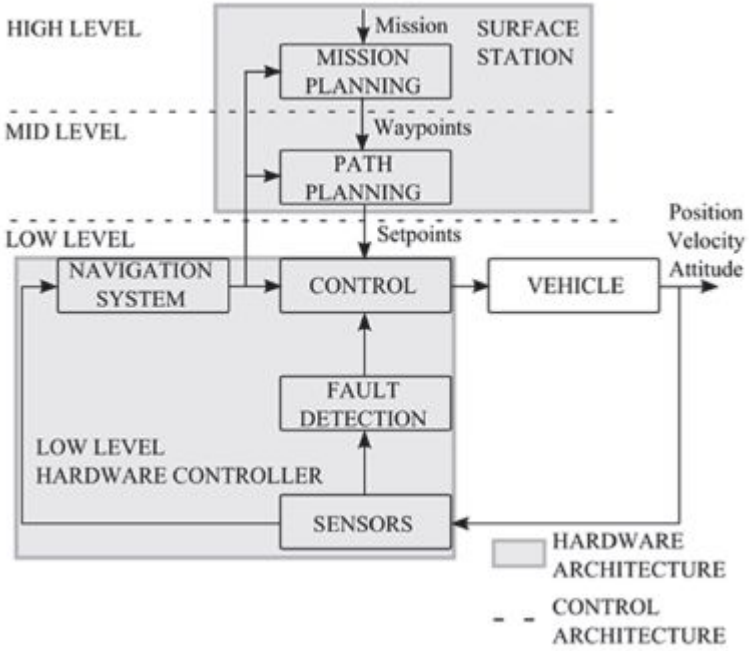
Five-thruster version

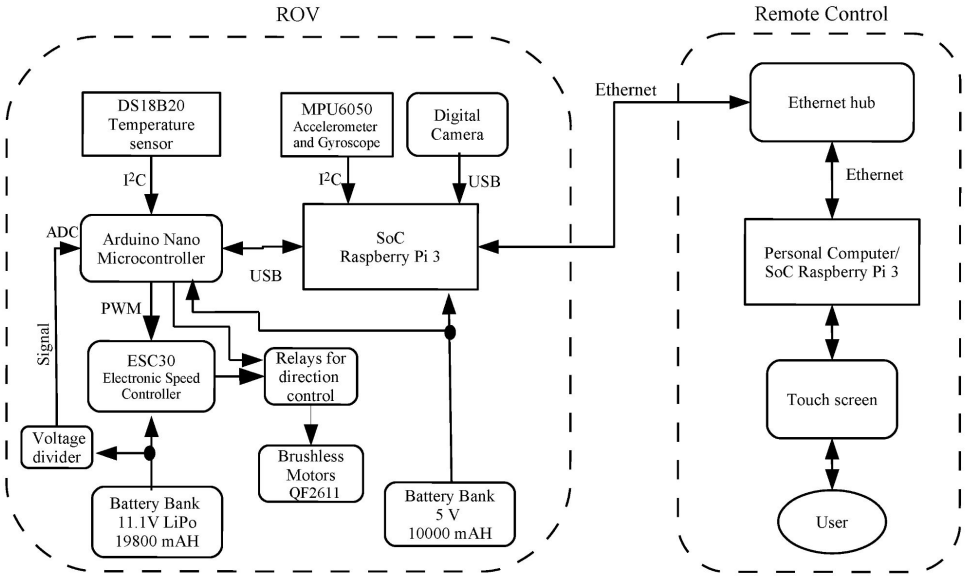

Vehicle counter-rotation
No vehicle torque steering
CB
CG
CB
CG
Prop rotation
Prop rotation
Counter-rotating prop
Prop rotation

Navigation & Control System of ROV

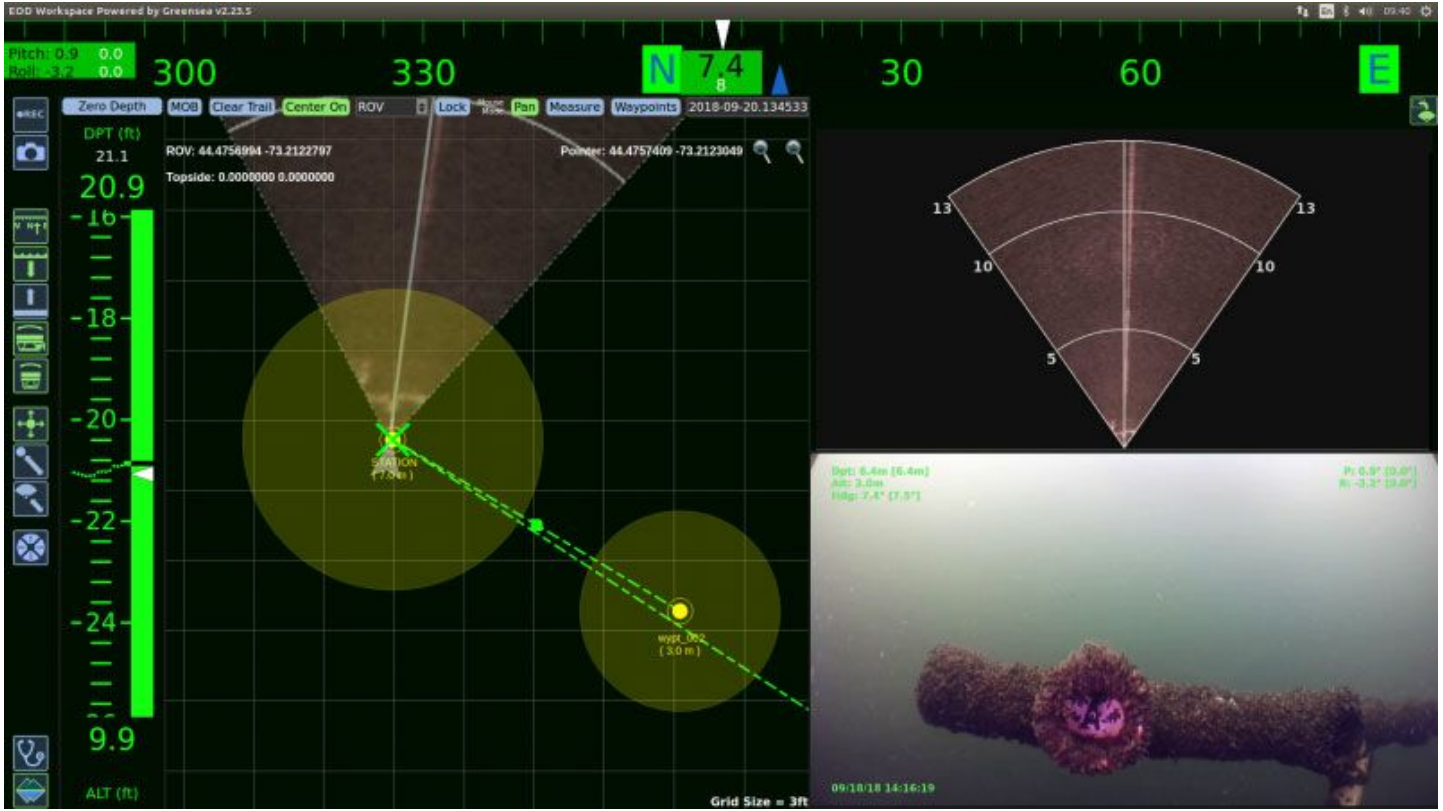


Control System





Control Software



Data Collection & Transmission

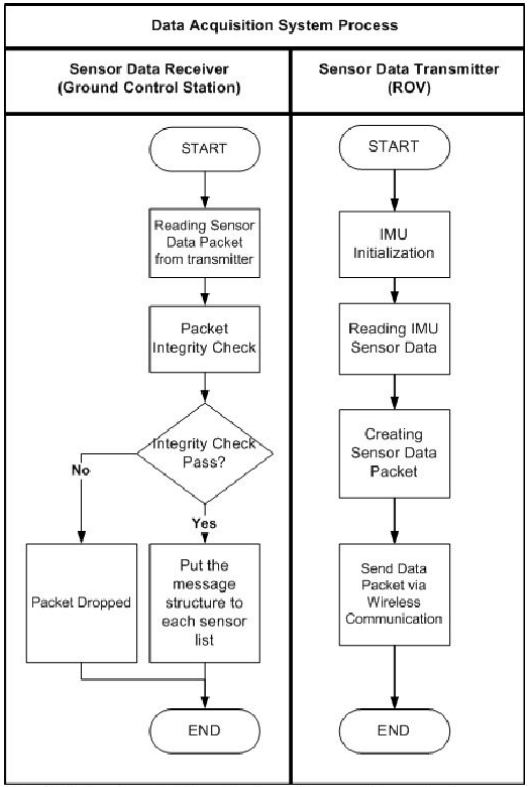
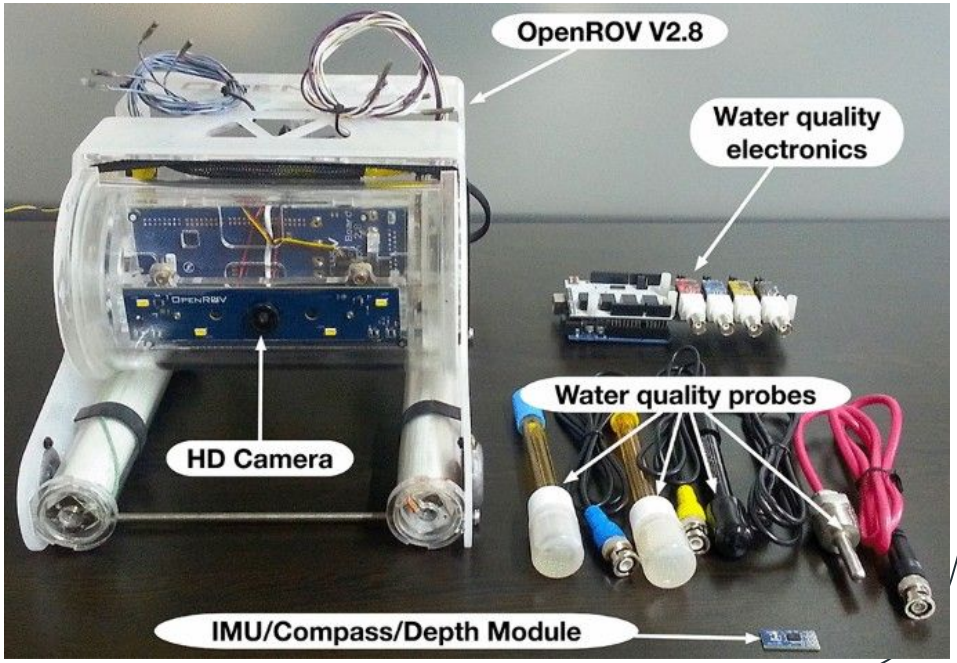
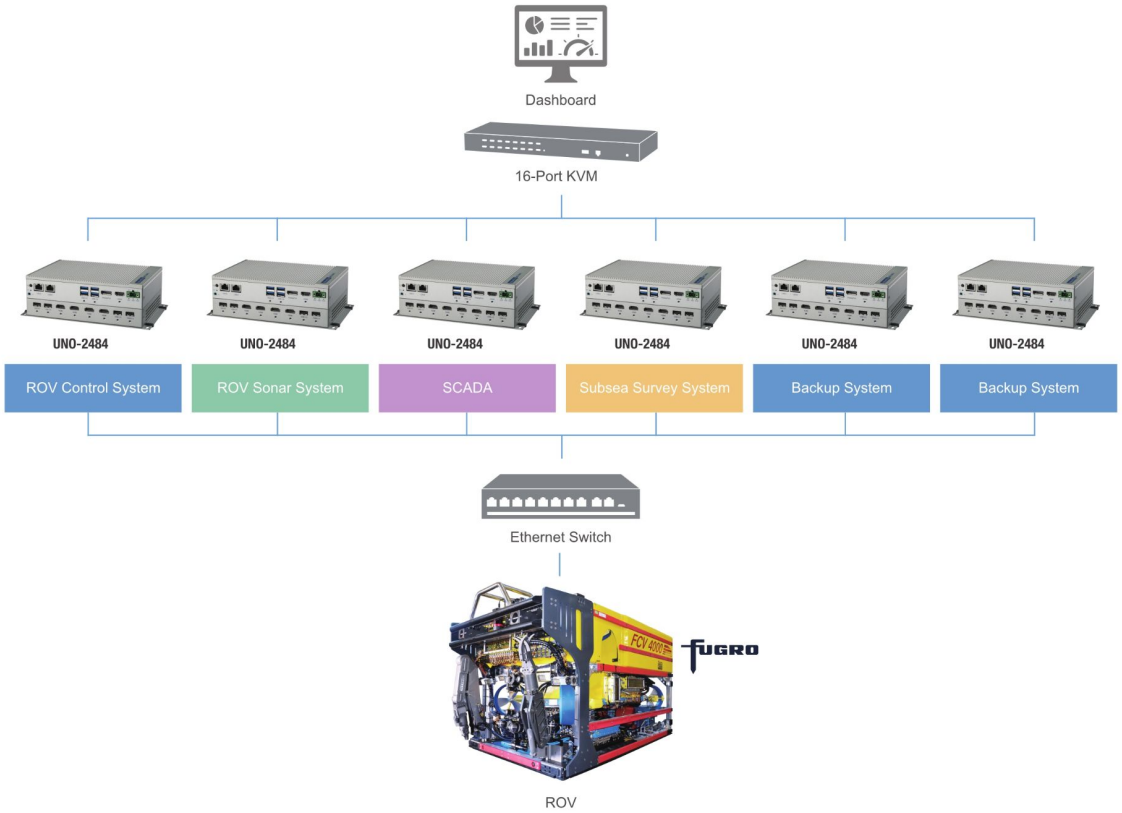


Fig. 3 Data Acquisition System Process Flowchart



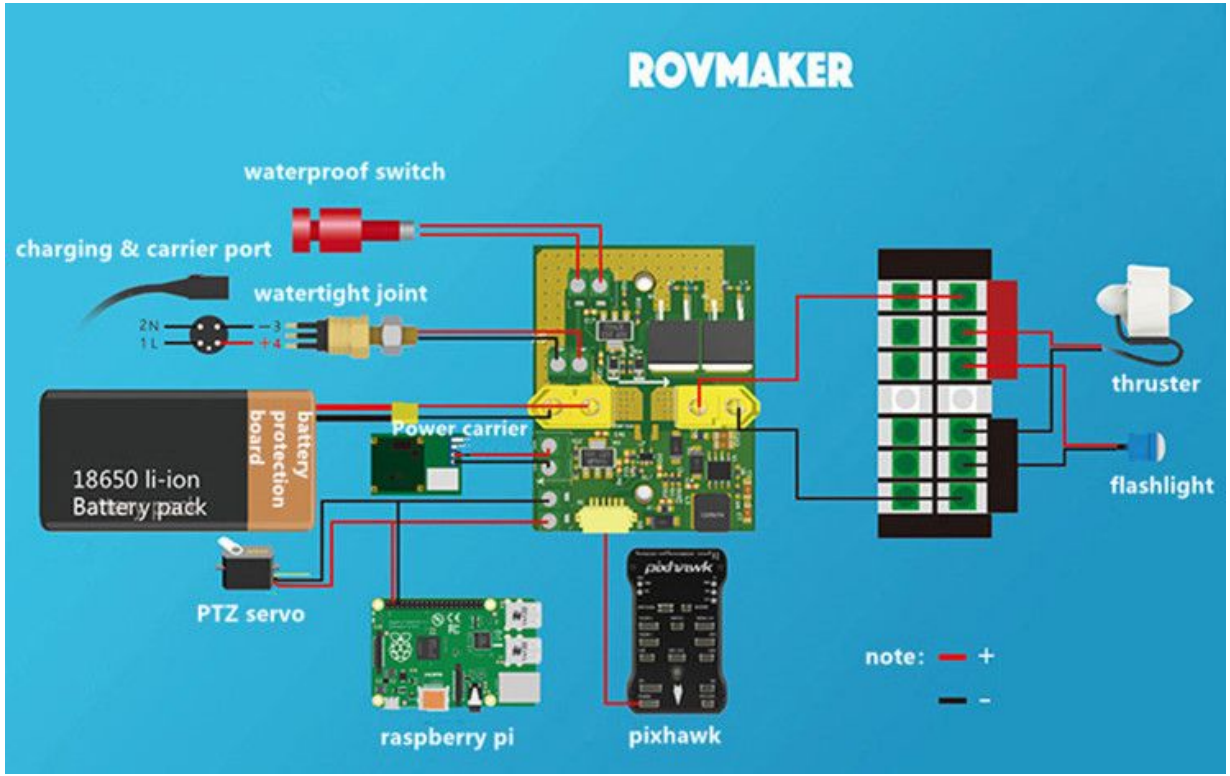

Dashboard
16-Port KVM
UNO-2484
UNO-2484
UNO-2484
UNO-2484
UNO-2484
UNO-2484
ROV Control System
ROV Sonar System
SCADA
Subsea Survey System
Backup System
Backup System
Ethernet Switch
FUGRO
ROV

Underwater Camera specifications

Part Name	Specification
Image Processor	Ambarella A7LS high-performance processor
Image Sensor	16MP Sony EXMOR R CMOS BSI image sensor
Lens	155° ultra wide angle glass lens / F2.8 Aperture
G Sensor	ST high performance g-sensor
Waterproof:	Waterproof up to 40 m deep with waterproof housing (sold separately)
Video Compression Format	High-definition H.264 image encoding
Video Format	MP4
Video	1080p@60fps, 48fps, 30fps, 24fps 960p@48fps 720p@120fps, 60fps, 48fps 480p@240fps
WLAN	Wi-Fi 802.11 b/g/n, Wi-Fi Direct, hotspot

Parameter	Sensor type	Model	Depth rating (m)	Comment
Navigation sensors			500	
Position	Acoustic Ultra Short Baseline (USBL) positioning system	Tritech Micron Nav	700 (10)	Range 500 m horizontal; 20 m Transducer cable
Obstacle detection	Scanning sonar	Tritech Micron Sonar	750	Range 0.3–75 m
Distance to sea ice	Sonar altimeter	Tritech PA500	700	Range 0.1–10 m
Pitch, roll, heading	Inertial measurement unit (IMU)	Micro Strain	–	
Depth	Pressure sensor	Ocean Modules	–	
Pilot awareness	Navigation camera	Bowtech L3C-720	4,000	
Illumination	LED lights	Bowtech LED-K-3200	3,000	2 × 3,200 lumens
Scientific payload			300	
HD-video	HD-zoom camera	Bowtech Surveyor WAHD	4,000	10:1 optical zoom
Still images	Photo camera	Imenco Tiger Shark	1,000	Internal flash, 4 × zoom
Manipulation	Manipulator	Sub-Atlantic 1F Manipulator	300	Grip force: 8 kg
Hyperspectral irradiance	Spectroradiometer	TriOS RAMSES ACC	300	320–950 nm, 3.5 nm resolution
Hyperspectral radiance	Spectroradiometer	TriOS RAMSES ARC	300	320–950 nm, 3.5 nm resolution
Hyperspectral extinction	Spectral transmissometer	TriOS VIPER G2	300	360–750 nm; 250 mm path-length
Chlorophyll, CDOM, backscatter	Triplet fluorometer	Wetlabs ECO-Puck bbfl2-SSC	600	Wavelengths (ex/em): 470/695, 370/460, 700 nm
Conductivity, temperature, depth	CTD	SBE GPCTD	100	Pumped
Dissolved oxygen	Optode	SBE 43F DO	600	Fast response membrane
pH		SBE 18 pH	1,200	Angled version
Nitrate	UV-spectrometer	Satlantic SUNA V2	500	190–370 nm, 10 mm path-length
Ice topography	Bathymetric multi beam sonar	Imagenex DT101	300	Range: 75 m; motion compensated

Power Management



Wall Outlet

OTPS Topside Power Supply Unit

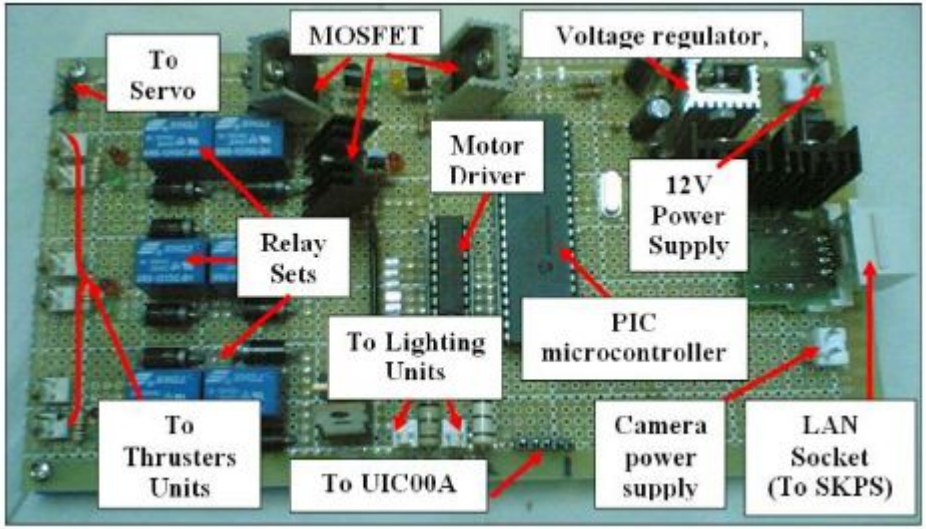
OTPS High-Power Tether

OTPS ROV Power Supply Enclosure mounted on a *BlueROV2*

100-240VAC

↑400VDC

↓15VDC


To Servo
MOSFET
Voltage regulator,
Motor Driver
12V Power Supply
Relay Sets
PIC microcontroller
To Lighting Units
To Thrusters Units
To UIC00A
Camera power supply
LAN Socket (To SKPS)

Thanks!

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