AN UNDERWATER CAPSULE VEHICLE

IITM Technology Available for Licensing

Problem Statement

- **Underwater capsule vehicles** facilitate critical deep-sea exploration, environmental monitoring, resource assessment, defense, scientific research **by safely transporting operators and obtaining diverse samples under high-pressure conditions**.
- **Conventional submersibles** use bulky sampling devices, limiting type diversity due to compact hulls, complex buoyancy controls, and **reduced interior space for multiple instruments.**
- Further**, most conventional capsules collect only a single sample type**, requiring separate devices, increasing weight, operator complexity, and reducing stability and maneuverability in dynamic underwater environments.
- There is a **need for an underwater capsule that simplifies operations, reduces complexity, and allows for a greater diversity of samples**, making it versatile and efficient.

Intellectual Property

- IITM IDF Ref 3013
- **IN 202441055987 Patent Application**

TRL (Technology Readiness Level)

TRL 2 Technology Concept formulated

Technology Category/ Market

Category- Applied Mechanics & Mechanical Engineering/ Robotics & Automation

Industry Classification:

Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing; Marine Robotics; Environmental Monitoring; offshore energy

Applications:

Environmental Monitoring; Marine Archaeology; Industrial Inspection; Gathering mineral or biomass samples; Research Expeditions

Market report:

The Global autonomous underwater vehicle market was valued at USD 3.42 billion in 2024 and is projected to grow to USD 16.85 billion by 2035 with a CAGR 15.6 %

Research Lab

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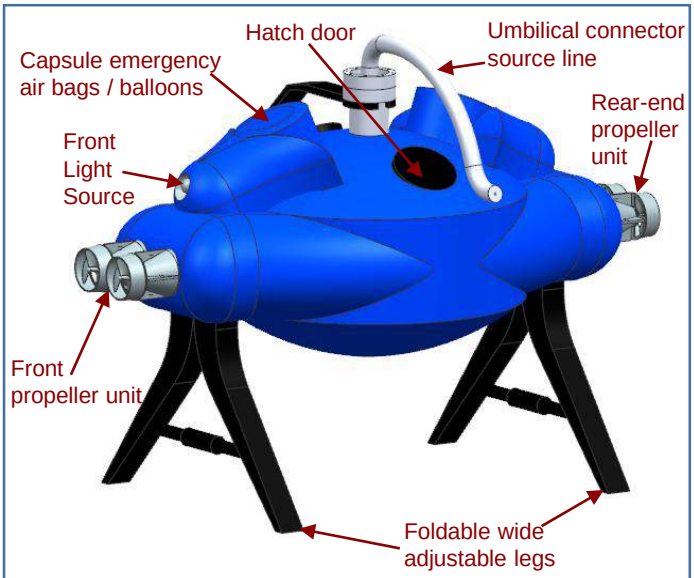

Figure: Illustration of the Personnel capsule assembly

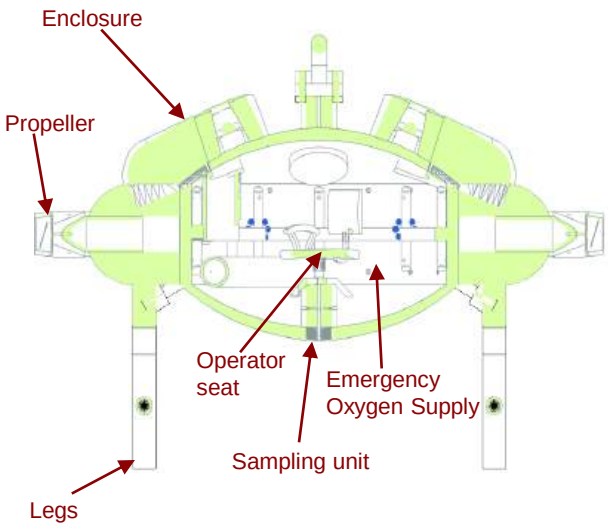

Figure: A partial sectional view of an underwater capsule vehicle with a sampling unit.

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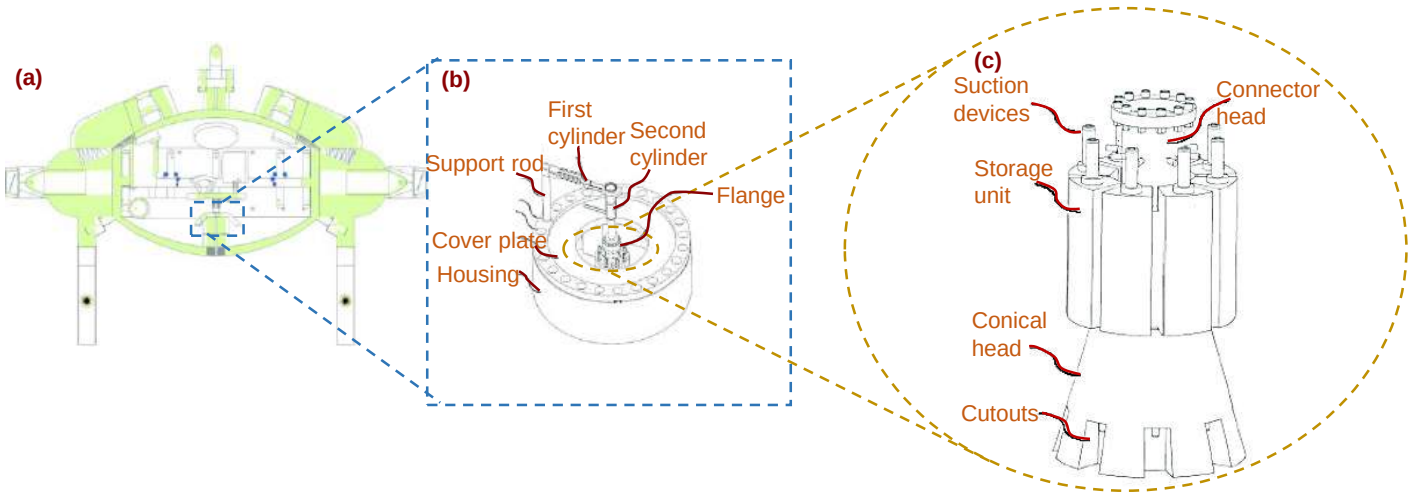

Figure: Illustrations of the **(a)** underwater capsule vehicle **(b)** perspective view of a deployment system coupled with the sampling unit and **(c)** The sampling unit. This dual-cylinder arrangement with perpendicular actuations of the deployment mechanism, provides a controlled and precise movement of the sampling unit

Technology

- A robust, pressure-resistant enclosure housing sampling units and propulsion mechanisms ensures durability in extreme underwater conditions.
- **The conical head of the sample collection system features concentric peripheral pockets, intermediate channels, and a central aperture—each linked to dedicated conduits—enabling discrete intake of solids, semi-solids, and liquids in a single deployment.**
- Each peripheral pocket houses an agitator consisting of a main cylinder, driving shaft, and cutter head; pressurized gas pulses stir the seabed surface, freeing compacted sediments for efficient peripheral channel intake
- A guide mechanism employing a support rod, perpendicular first and second cylinders, and a bottom shutter permits precise vertical and lateral positioning of the sampling unit through the hull, ensuring stable seabed contact.
- Cutouts in the head house sensors, LEDs, and cameras linked to an onboard control unit—providing real-time detection of sample types, optimized actuator control, and visual confirmation to the operator.

Key Features / Value Proposition

- Simultaneously collects solid, semi-solid, and fluid samples via dedicated peripheral, intermediate, and central channels, eliminating the need for multiple devices.
- Peripheral storage units with check-valve and suction devices secure each sample type separately, ensuring contamination-free collection and increased onboard capacity.
- Pneumatically driven agitators in each pocket stir sediments before intake, improving recovery of settled solids and heterogeneous mixtures.
- Dual-cylinder cantilever guide mechanism and shutter allow accurate, repeatable positioning of the sampling head on uneven seabed, enhancing operational efficiency.
- Embedded sensors, illumination units, and cameras provide real-time feedback for sample detection and verification, reducing trial-and-error and mission risk.

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