

Aqua2

The Aqua2 is an amphibious hexapod robot capable of propelling itself on land or through the water. The use of six independently controlled thrusting surfaces makes the unit very maneuverable and produces minimal disturbance to the surrounding environment.

The Aqua2 is programmable and configurable, can be deployed for tethered or untethered use, and is an ideal platform for submersible robotics projects, environmental monitoring, and propulsion research.

Product Features and Benefits

- **Ruggedly constructed** using high grade aluminum and resistant to minor bumps and scrapes. Appropriate for use in surf zones or coral reefs, brackish water or reedy environments. Ballast system protects against seawater corrosion.
- **On-board control computer** operates 6 independent servo motors for a variety of locomotion modes. Users can program or tune their own control parameters using a 1 kHz closed loop control cycle. Includes data logging applications for robot control parameters and telemetry.
- **Quick-replace battery** packs allow near-continuous operation. Each battery set provides five hours of vehicle operation.
- **ROS compliant programming** allows developers to quickly build their own application using existing ROS development libraries.
- **Vision processing:** Available second onboard computer and software specialized for image and video acquisition and computationally intensive vision tasks. Includes viewer software for remote video observation.
- **Front and rear camera modules:** mounted digital cameras suitable for navigation, data acquisition or stereo reconstruction of the local environment. Included mirror allows simultaneous downward/forward view.
- **Waterproof optical tether system:** a waterproof fiber optical cable provides standard TCP/IP communication between the vehicle and off-board computers.
- **Easy to deploy:** Does not require special launch systems. Preparation and maintenance checklists help ensure proper operation and robot protection. Available shipping containers are transportable as standard luggage by commercial airlines.

Specifications

Mass	16.5 kg
Envelope Dimensions (cm)	13 x 44 x 64
Speed on Land	0.7 m/s
Speed in Water	1.0 m/s

Navigable Environments:

- Water: fresh and seawater, surf zones
- Land: dry, mud, sand, snow
- Operating Depth: 100 ft.
- Intended Operating Range: 100 ft.
- Temperature Range: 0-60° C

Control:

- Autonomous Mode:
 - 6 independently controlled fins, programmable
- Teleoperated Modes:
 - Walk: forwards, backwards, walk in arcs, or turn in place (sit/stand functions)
 - Underwater: user-controlled forward propulsion, pitch, yaw, roll control, and hover in place function
 - Tunable parameter sets for optimized locomotion

Materials

- Flippers: vinyl with spring steel inserts
- Legs: fiberglass spring with rubber tread
- Body: aluminum

Batteries

- Chemistry: Lithium Ion
- Weight: 1.4 kg
- Voltage: 28.8 V
- Capacity: 7.2 Ah @ 2 amps
- Operational time: 5 hours
- Charge Time: 8 hours (standard), 3 - 4 hours (optional)

Computers

- Control Stack: Control Processing Computer
AMD Geode 500 Mhz Processor, CF Memory, x86 compatible
- Vision Stack: Optional Vision Processing Computer,
Intel® ATOM D525 1.4 GHz Processor, CF Memory,
Intel® Graphic controller: Extreme Graphics 2
- Optional Wireless Ethernet: (802.11g) communication to computers when operated out of the water

Available Sensors:

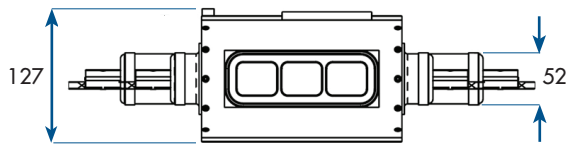
- USB Cameras: 1024 x 728 resolution, 15 frames/sec
- IMU Resolution:
 - Rotation: 0.1°
 - XYX Acceleration: 0.2 g
 - Magnetometer: 0.2 mGauss
- Depth Sensor:
 - Range: 0-75 psia
 - Accuracy: 0.5%

Available Documentation

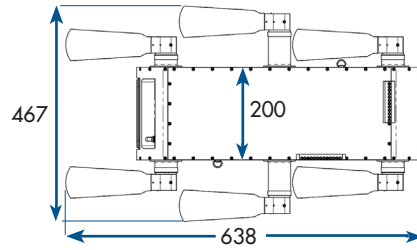
- Aqua2 Robot Users Guide
- Aqua2 Robot Programmers Guide
- More information available on www.mobilerobots.com

Aqua 2

Dimensions (mm)



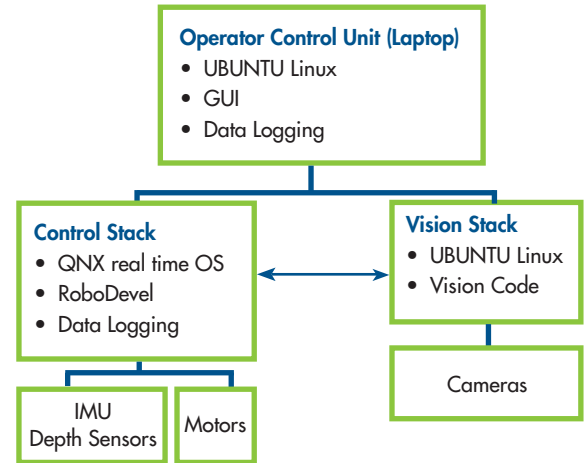
Front View



Top View

Programming and Control Architecture

A dedicated on-board computer (control stack) handles the gait or swim control of the robot. The control stack is also where movement, telemetry, and depth sensor data is processed for forwarding to the Operator Control Unit for data logging. An optional vision stack is available for image processing and high-level movement control during autonomous operation. Applications are available for basic robot operation, access to telemetry and control parameters, and image acquisition. Video processing and recording applications are based on the ROS development environment and the OpenCV vision library. New applications may be developed using available C++ libraries and programming guides.



Aqua2 Packages

Mobility Base	Basic Vision	Complete Vision
Features <ul style="list-style-type: none"> Robot shell and ballast system Actuator system (motors and driver) On-board power supply Two batteries and two slow chargers Control stack (only) Half-circle land legs for walking Flippers for swimming Robot Control Software Package Computer breakout connector 'Wired' Ethernet link <ul style="list-style-type: none"> Robot GigE to fiber converter Fiber Cable (10 m) Operator GigE to fiber converter 	All Mobility Base features, <i>plus</i> <ul style="list-style-type: none"> Wireless Ethernet link <ul style="list-style-type: none"> Robot 802.11 transceiver External antenna Vision Stack <ul style="list-style-type: none"> Intel® ATOM D525 1.4GHz Processor 2 USB video cameras Downward facing mirror Image collection/display software IMU (Roll-Pitch-Yaw, XYZ acceleration, +magnetometer) Depth sensor <ul style="list-style-type: none"> Configurable for fresh or seawater 	All Mobility Base and Basic Vision features, <i>plus</i> <ul style="list-style-type: none"> 1 additional USB camera (3 total) Preconfigured Operator Control Unit: ruggedized waterproof laptop, magnesium alloy case rated for salt/fog operation 50 meter armored cable 200 meter armored cable Shipping case Accessories shipping case Maintenance Toolkit Additional Ballasting AC/DC adapter for bench top operation Customized clothing with IRI/Aqua2 logo
Functions <ul style="list-style-type: none"> Teleoperated on land or water (line of sight only) Internal state data collection Communicate underwater (fiber optic data link) or on land (Ethernet) 	Additional Functions <ul style="list-style-type: none"> Communicate via wireless data link (Ethernet) on land Observe and collect live video data Measure inertial parameters and depth 	Additional Functions <ul style="list-style-type: none"> LCD display from robot to nearby operator for use underwater Completely accessorized for indoor/outdoor/remote operation



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