

OCEAN ROBOT CLEANER

Group 5 - Tam Le, Zain Ali, Sai Rohan Kakarlapud, Om Goyal

The **ORCA** or Ocean Robot Cleaner (Autonomous), is a waterproof, surface-floating robot designed to collect trash and human-made pollution from bodies of water. ORCA assists organizations, societies, and researchers who want to reduce the environmental impact of human-made ocean surface debris on water ecosystems. It is mainly autonomous, following predetermined routes or free exploration (going wherever there is trash), and returns to the base to offload collected debris. However, users can step in at any time to manually control the robot if emergencies or technical issues arise. A web-based user-friendly interface displays important real-time information about the robot, such as location, coverage area, travel history, and amount of trash collected. The GUI also allows users to create custom routes as well as manual recall of the robot during emergency situations.

This first scenario describes the usage of the ORCA's MVP (minimum viable product) version with the following core features: autonomous navigation, surface-level trash collection, and real-time reporting and control of crucial information through a web-based interface. These foundational capabilities form a solid base for further enhancements and advanced functionalities we plan to implement in future iterations.

Scenario “Robot Setup and Usage”

Users deploy a fleet of ORCA robots through a web-based interface, specifying a route. The UI gives weather data so the user can make an optimized route decision. Each robot is physically placed into the water and is designed to withstand typical splashing and surface disturbances. Users establish a connection between the robots and the interface, which allows them to monitor and control operations as needed. The interface provides key data such as the robot's location, travel history, battery levels, and trash collection status, and allows explicit control over propulsion, trash collection, and route edits.

During operation, ORCA relays real-time updates to the user interface, allowing remote users to track progress and system status. In case of emergencies—such as extreme weather, hardware malfunctions, or an unexpected environmental hazard—users can override autonomous control and manually recall the robot to base. ORCA is also programmed to autonomously return to base if its battery reaches a critical level or if its trash collection compartment reaches full capacity.

Upon returning to the base, the user offloads the collected debris into a designated disposal unit. Users have the option to inspect the robot for maintenance, clean filters, or replace parts before redeploying it for further cleanup operations. Additionally, after each cleanup session, ORCA

uploads its operational data—including the quantity, the total area covered, and water quality metrics—to a centralized database. This information is analyzed to generate detailed reports on pollution patterns, helping researchers track environmental changes over time and optimize future cleanup efforts.

Activity Diagram of Robot Setup and Usage Scenario

