Calit2's Reefbot Designed to Autonomously Monitor Ocean's Disappearing Coral Reefs

December 18 2008, By Tiffany Fox

The Reefbot is relatively compact, autonomous surface craft designed to continuously collect data pertaining to the oceans' littoral zones, where most coral reefs are located.

(PhysOrg.com) -- The world's coral reefs are vanishing at an alarming rate, but the oceanographers who study the underlying causes of reef destruction are often hindered by slow, tedious and sometimes dangerous methods for collecting important data.

"What they need is something like Reefbot," says Doug Palmer, Principal Development Engineer at the University of California, San Diego division of the California Institute for Telecommunications and Information Technology (Calit2). The Reefbot (also known as the CalOdyssey) is a relatively compact, autonomous surface craft designed to continuously collect data pertaining to the oceans' littoral zones, where most coral reefs are located. As creator of the device and a self-proclaimed "coral reef nut," Palmer predicts that Reefbot could become a standardized platform for reef researchers the world over.

"Reefs are very complex beasts, with millions of interactions and systems at play at any given time," he notes. "They're basically the canary in the coal mine for the planet Earth, since they're very sensitive to changes in pH level, carbon dioxide emissions, rising temperatures and pollution." As point of fact, a new report released last week by the International Union for Conservation of Nature (IUCN) confirms that the world has lost almost one-fifth of its coral reefs, and suggests that if measures aren't taken to curb global warming, unmanaged tourism, and destructive fishing techniques like dynamite fishing, remaining reefs could be completely wiped out by the year 2050.

"As hard as oceanographers are working to understand what's happening to the reefs, they're collecting very little data," Palmer cautions. "Graduate students are getting up at the break of dawn, going out on the boat and coming back at dusk having only collected a few data points, when they need hundreds of thousands of data points. Having an automated craft that could be programmed from a laptop to explore a range of many hundreds of miles would be invaluable."

With a capacity for hosting an array of scientific instrumentation, Reefbot has virtually endless applications. The system could, for example, be used as a "Marine Sanctuary Patrol" to locate and identify reef intruders; detect poaching and over-harvesting; maintain fish counts; detect and track pollutants; and create long-term digital imaging records of the reef habitats. Turbidity, temperature and salinity instrumentation would allow it to track beach sand flow, erosion and estuarine "dead zones," or the boundary between anaerobic and marine water. The craft could also be outfitted with instrumentation for water sampling; detecting ocean currents, wave or surf conditions; and conducting accurate bathymetry or acoustic monitoring.

Equipped with a camera and GPS (global positioning system) device, the 12- to 14-foot Reefbot also could be used to digitally map coral reef systems to produce a GIS software tool for tracking changes down to the nearest centimeter.

"We want to extend Google Earth into the ocean realm," explains Palmer. "You would literally be able to zoom down under the water and look at the corals, year after year."

Although Reefbot exists as a prototype only on paper, Palmer has been working with a number of colleagues to develop its capabilities. Calit2 Staff Engineer Daniel Johnston created the prototype mechanical design, and Calit2 Principal Development Engineer Don Kimble has conducted functional analysis testing for the craft. In addition, Associate Professor of Computer Science and Engineering (CSE) Ryan Kastner and CSE Ph.D. candidate Bridget Benson are developing a compatible underwater transducer or modem that would be able to transmit data from underwater sensors to the Reefbot as it passed overhead.

Palmer says that with current methods for recording temperature, for example, "You have to make a $100 instrument and drop them all over reef, and then you have to somehow retrieve the data. If you equip the sensors with batteries and try to transmit the data ultrasonically through seawater, you run the batteries down quickly. This means you have to go out there and constantly maintain the sensors, and if you have hundreds or even thousands of these out there, that's just not practical to maintain."

But with the Reefbot/transducer combination, Palmer says, "Now the modem only has to transmit very low energy, so the batteries would last about five years.

"Reefbot could monitor the reefs all day, taking photos and collecting data from the transducers and its internal sensors, and then pop into the dock and transmit the data at a high speed to the computers there, all while being refueled."

As for core design considerations: "Ninety-five percent of the Reefbot would consist of parts you could buy at a marine store," Palmer says, estimating that it would cost $50,000 to construct a single aluminum craft. Onboard navigation, all-weather communications and failure detection would make it seaworthy in all conditions, and "even its generator would be the kind of generator you'd find on a yacht," he notes.

"The propulsion system would be diesel electric, like railroad locomotives, but with a few heavy marine batteries to store energy and drive it when you want it to be very quiet. The number one challenge for the Reefbot is sensing and avoiding obstacles. We don't want it running over swimmers or into piers, so we've outfitted it with a video camera and a powerful computer, so it will be smart enough to avoid obstacles. Reefbot's seaworthiness would also be an asset in the rough waters of the littoral zone, where rocks and high surf make it dangerous for other craft to travel, he adds.

"Plus, it’s never going to go very fast — we're talking about a craft that, most of the time, will be traveling at two knots. Even if a swimmer or snorkeler is nearby, it won't affect them much. With the little black ball on top of it, people will be able to see it and steer around it. There's all kinds of stuff out there in the ocean — people are used to steering around these things. But even so, it could get clobbered and still stay afloat."

Once Palmer has secured funding to develop a prototype of the craft, he'll work with local oceanographers to conduct experiments first off the coast of La Jolla (where UCSD is located) and then with UC Santa Barbara professors of Ecology, Evolution & Marine Biology Russell Schmitt and Sally Holbrook at the Richard B. Gump South Pacific Research Station. The National Museum of Marine Biology and Aquarium of Taiwan has also expressed interest in using the Reefbot to monitor its artificially created reefs, as well as those in Taiwan's heavily threatened natural reefs (which, according to the IUCN report, are under severe stress). Palmer says the craft could even be used as part of underwater archaeology expeditions.

"We've even pitched the Reefbot as a tool for river patrols and looking for mines in shallow water," he notes. "They could equip it with a small bathymetric device and image the river bottom even in extremely dirty water."

But regardless of its secondary applications, Reefbot (as its name implies) is designed primarily to keep the health of the world's reefs in check, on the cheap.

"We expect Reefbot to become the workhorse tugboat of the marine biology community," he predicts. "Oceanographic labs are sending people out to the ocean all day, every day. People get bored doing same thing over and over. That's the one thing that's nice about computers, they don't complain. And imagine the cost involved! With Reefbot, you can collect a lot more data a lot cheaper. The cost to operate this thing would be on the order of $2 an hour, and that's hard to beat. That's even cheaper than graduate students!"

Provided by University of California, San Diego

(2008, December 18) retrieved 18 April 2024 from https://phys.org/news/2008-12-calit2-reefbot-autonomously-ocean-coral.html