DARPA develops drones to deliver payload and then self destruct to avoid drone capture incidents

A Chinese navy submarine rescue vessel launched a small boat and seized the US drone which the Pentagon also called an "ocean glider." The Pentagon said the Chinese ship ignored repeated demands to return the vehicle from the USNS Bowditch. One week later the Chinese government has returned the US underwater drone it siezed in the South China Sea, according to Chinese and US officials. The Pentagon said the United States would continue to investigate the "unlawful" seizure, which took place in international waters about 50 miles northwest of Subic Bay in the Philippines.

In 2014, Iran claimed to have developed a stealth drone which it says is copy of US RQ-170 Sentinel, made by Lockheed Martin. "The drone was brought down by the Iranian Armed Forces' electronic warfare unit which commandeered the aircraft and safely landed it," the Iranian Tasnim News Agency reported. Late 2014, Iran announced it had "managed to reverse engineer most parts" of the drone, according to the Tasnim report. In 2011, U.S. "stealth" Blackhawk helicopter that crashed during the commando raid that killed Osama bin Laden was given access to China by Pakistan despite explicit requests from the CIA not to, the Financial Times reported.

U.S. Defense Advanced Research Projects Agency (DARPA) launched "Inbound, Controlled, Air-Releasable, Unrecoverable Systems" (ICARUS) program to prevent incidents like this from happening. The goal was to create drones that would be deployed from an aircraft, deliver their payloads, and literally disappear.

Using its Ghost expendable glider, DZYNE flight testing recently proved aerodynamics and controls necessary for autonomous delivery of a small, three-pound payload. Developed under contract through the Defense Advanced Research Projects Agency's (DARPA) ICARUS program, Ghost is a small, robotic cargo glider that will allow precision supply drops for those in the field. Currently, supply to small military or civilian teams in difficult-to-access territory requires large, parachute-based systems that must be carried out or otherwise disposed of, for operational security and environmental concerns. It can be challenging to get a parachute-based system to deliver cargo precisely in an area surrounded by trees or buildings. The Ghost air vehicle uses a novel air vehicle design and flight control methodology to eliminate these challenges.

Inbound, Controlled, Air-Releasable, Unrecoverable Systems (ICARUS) program

DARPA awarded contracts to three companies the MORSECORP, PARC, and DZYNE to develop a vanishing unmanned aerial vehicle (UAV) able to deliver a small package no larger than 3 pounds to a GPS-programmed location with 33-foot accuracy. The vanishing air vehicles, which the companies will develop to operate at night that can complete their mission like making precise deliveries of critical supplies and then must be able to vanish within four hours of landing, leaving remnants no larger than 100 microns – or about the width of a human hair.

In one program-driving scenario, troops are called upon to deliver food, perishable vaccines, insulin, and blood and plasma products to widespread, difficult-to-reach destinations in the aftermath of an earthquake or tsunami. The option to forget entirely about the remains of all those delivery vehicles once they have done their job would relieve response teams from the logistics task of packing and transporting the

vehicles out of the affected region while essentially eliminating environmental impacts from the vehicles' deployment.

Today the supply and re-supply of small military and civilian teams in rough terrain, such as sniper teams and Special Forces, requires large parachute-delivery systems that must be packed-out after payload delivery for security and environmental concerns. Vanishing precision-delivery vehicles would enable efficient resupply to teams in distributed locations, eliminate the need to pack-out delivery parachutes, and deliver time-critical humanitarian supplies to personnel serving in remote or dangerous areas, DARPA officials say.

In a military context, access to small, unmanned delivery systems whose structural and avionics components were made with transient materials could ease the provision of, say, water, batteries or emergency medical supplies without adding to a unit's pack-out-burden.

"Inventing transient materials, devising ways of scaling up their production and combining those challenges with the hard control and aerodynamic requirements to reach the precision and soft-landing specs we need here makes for a challenging and compelling engineering problem."

Among the ephemeral materials so far have been developed are small polymer panels that sublimate directly from a solid phase to a gas phase, and electronics-bearing glass strips with high-stress inner anatomies that can be readily triggered to shatter into ultra-fine particles after use.

The program builds on recent innovations in its two-year-old Vanishing Programmable Resources (VAPR) program, which has developed self-destructing electronic components. "Our VAPR program partners are developing structurally sound transient materials with mechanical properties that exceeded our expectations," says Troy Olsson, program manager of VAPR and

ICARUS for DARPA.

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DZYNE Technologies developing technology advances in DARPA's ICAURS project

The Ghost demonstration took place July 17-19, and featured gliders built from a non-vanishing material that mimics the physical properties of vanishing materials. The gliders were dropped from balloons to conduct 15-mile, cross-country flights, ending with a steep, precision-guided approach to a defined target.

"The successful flight testing of the Ghost air vehicle demonstrates DZYNE Technologies' exceptional capability in designing a purpose-built unmanned aircraft to fulfill a challenging mission profile," said Darrell Gillette, DZYNE Technologies CEO.

Patrick Wright, Ghost Program Manager, remarked, "This is exciting for DZYNE because Ghost becomes the starting point for a whole family of autonomous cargo delivery systems."

DZYNE is developing manufacturing processes that will allow Ghost gliders to be built using the vanishing structural

materials developed under the DARPA Vanishing Programmable Resources program (VAPR).

MIT-founded Morse Develops Single-Use Disappearing Drone for DARPA

According to MIT, the Morse, which stands for Mission-Oriented Rapid-Solution Engineering, began working on its promise to create a disappearing drone that could fly 100 miles, land within 30 feet of its target, and dissolve within four hours or within 30 minutes of the sun rising.

Morse CEO Andreas Kellas admitted that this is anything but easy. “Developing an aircraft that can meet the accuracy and range requirement alone is a challenge,” said Kellas. “But add in the disappearing requirement and the problem becomes nearly impossible. That’s when you have to apply the MIT mentality: be creative, tenacious, and figure out how to make the impossible happen,” he added. One year later, and Icarus has reached “advanced research stage,” bringing the once seemingly impossible task closer to reality.

You might be wondering what the functional purpose is, of a drone that’ll vanish without a trace. According to MIT, DARPA was keen on producing such UAVs in order to deliver important payloads such as antivenom or plasma, as well as tools to people in remote areas or dangerous territories where detection of drones could further the threat of reprisals.

Kellas explains, “Our warfighters and those of our allies often operate in forward areas where their discovery would compromise their safety. This system would enable the resupply of lifesaving antivenin, blood transfusion kit, and other critical items without compromising their position.”

To make the disappearing drones a reality, MORSE developed a

self-flying vehicle that is made from lightweight film that contains a guidance system smaller than a tennis ball. The vehicle is made of specially developed polymers that, when exposed to heat or sunlight, quickly depolymerize, or disintegrate, into a clear liquid substance, leaving only the guidance system and delivered supplies upon landing.

The MORSE team demonstrated a successful official high altitude flight test earlier this summer, followed by a successful depolymerization demo of its disappearing material.

Swarms of Disposable Drones Will Make Critical Deliveries and Then Vanish

Existing autonomous supply vehicles have a multitude of limitations, including landing accuracy, cost, and a need to recover the system after deployment. Resupply systems such as parachute or UAV-based solutions use expensive vehicles that must be retrieved. The battery capacity required for return trips displaces payload capacity, the vehicles are costly to mass produce, and may require transport of heavy launch/land infrastructure.

As recipients of an ICARUS seedling effort, Otherlab has developed heavy-duty cardboard gliders which can deliver supplies and then disappear in a span of days. These gliders, while capable of re-use, are designed to be expendable and biodegradable.

The Otherlab system, the Aerial Platform Supporting Autonomous Resupply Actions (APSARA), pairs advanced computational design techniques with low-cost fabrication methods for rapid airframe development. The designs are adaptable to mission-specific payloads across a range of production scales. APSARA vehicles have a long shelf-life, can be cheaply assembled, and flat-pack for shipping, to be folded into form when needed.

APSARAs are customizable, can be assembled in theater, and benefit from being constructed from a low-cost, high-availability material.

APSARAs are ideal for delivering humanitarian payloads to the most remote areas. Capable of carrying low thermal loss canisters and medically sensitive fluids, APSARAs can transport blood and vaccines — often most critically needed in regions with undeveloped road and runway infrastructure.

They may also enable the delivery of other equipment, such as batteries, to specific locations. APSARAs enable distributed delivery with precise landings, solving the "last leg" problem for battlefield or low-infrastructure locations, and reducing supply chain vulnerability.

In one operational concept, a C-17 (or C-130) could be equipped with several hundred APSARA gliders, each loaded with critical medical supplies and preprogrammed with delivery coordinates. The combined range of the large transport and the gliders deployed from it would allow the single airplane to conduct delivery operations covering an area the size of California.

According to Star Simpson, Otherlab's APSARA project engineer, "we used cardboard as a prototyping material because it is easy to work with and resembled mycelium, the mushroom-based material that we intend for the future product." Like mushrooms, Simpson says the design can grow. "We can currently carry up to a one-kilogram payload, and we know we can pretty directly scale the airplane up to about an 8-foot wingspan and carry 10 kilograms with no problems."

Otherlab has experimented with a variety of landing techniques, but for now, they've settled on a spiral down to a controlled crash landing.

NASA invents self-destructing bio-drone made of fungus and bacteria

A biodegradable drone made out of fungus, bacteria and wasp spit built by NASA-affiliated scientists may pave the way for future spyware, which would simply self-destruct if it crashes, leaving behind only minute remnants.

The biological drone would simply melt away, according to its designers. “No one would know if you’d spilled some sugar water or if there’d been an airplane there,” Lynn Rothschild of NASA’s Ames Research Center in California told New Scientist. The model was conceived by a group of scientists from across Stanford, Brown and Spelman College.

The main body is primarily made of a fungal material called mycelium which was covered by the outer skin made out of bacterial cellulose sheets, which were grown in a laboratory and take on a sticky, leathery type consistency. For waterproofing, the device was coated in proteins, which had been cloned from paper wasps’ saliva – what they use to gel their nests together and waterproof them.

However, at present key components like electronics, propellers and batteries are not bio-degradable. The team has expressed a desire to develop sensors made out of E. coli bacteria. “There are definitely parts that can’t be replaced by biology,” team member Raman Nelakanti of Stanford University told New Scientist.

https://www.youtube.com/watch?v=mJHt4wA_cp4

Vanishing electronics based on tempered Glass

Gregory Whiting, a materials scientist and manager of the Novel Electronics Group have developed a new computer chip made of tempered glass, which when remotely triggered could self destruct itself in seconds and keep the sensitive data secure. The new method utilizes silicon computer wafers attached to a piece of tempered glass, which when heated in one spot shatters into small pieces.

Tempered glass is about four times stronger than “ordinary,” or annealed, glass, and unlike annealed glass, which can shatter into jagged shards when broken, tempered glass fractures into small, relatively harmless pieces.

Normally tempered glass is made by heating in oven at a temperature of more than 600 degrees Celsius and then undergoing a high-pressure cooling procedure called “quenching.” Due to this process, the exterior of the glass contracts, putting the exterior into compression while the interior that is warm maintains extraordinary tensile stress. The heat-tempering process only works with pieces of glass that are at least 0.03 inches thick, as glass is a poor temperature conductor. Also, it requires thinner materials to produce tiny particles.

Researchers used an alternate method called ion exchange. The researchers began with a thin piece of glass that was rich in atoms of sodium, or sodium ions, with one electron stripped off. The glass was then put into a hot bath of potassium nitrate. Potassium ions then try to exchange places with the sodium ions. However, this produces enormous tension in the glass, as the heftier potassium ions must squeeze into place within the silicon matrix, Whiting said.

The new method provides the option to either attaching silicon wafers directly to the glass, or fabricating the two together.

The team to induce chip suicide triggers the chip with a tiny heating element, which causes a thermal shock that creates a fracture that spreads throughout the glass. The recent chip demonstration relied upon the laser triggering a photo diode, which switched on the self-destruct circuit. Future versions of the chip could use anything from mechanical switches, or Wi-Fi to radio signals as triggers.

PARC Successfully Demonstrates Electronics that Disintegrates on Demand

PARC performed several dozen live demonstrations of the transient technology, The self-destructing chip was on display last month at DARPA's "Wait, What? Technology Forum" in St. Louis, where attendees used a standard laser pointer to provide a remote logical signal that triggered a current pulse in a resistive heater which provided the energy needed to initiate a defect and disintegrate PARC's electronic device within a couple of seconds. While an optical signal was used in this demonstration, PARC's technology can also be triggered via a radio frequency signal as well as physical or chemical triggers.

Previous research by the U.S. Air Force Institute of Technology has also considered using a tiny resistor heater that could cause critical circuits to self-destruct to prevent reverse-engineering. Researchers at Iowa State University also have reported progress in working with "transient materials" used for electronics, passports or credit cards that could degrade on command.

Parc, a part of Xerox, has extended its multimillion dollar contract with DARPA to develop its Disintegration Upon Stress Release Trigger (DUST) technology under DARPA's Vanishing Programmable Resources program.

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