

Smaller is Smarter: Nano Drones

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The Wright brothers had big dreams when they took off for their first flight at Kitty Hawk. Those big dreams turned into bigger plans in our globalized world for mankind to dominate the skies with massive aircraft to move more people and supplies with each takeoff. However, the 21st century has produced a "smaller" innovation to take over the skies with much bigger capabilities and applications than ever imagined. Small Unmanned Aerial Systems or drones have littered the skies for centuries, but nanotechnology has now reduced their size even more. Nano drones have proved to be invaluable in the defense industry and simpler, inexpensive designs are purchased for recreation use every day. Their reduced size and lightweight characteristics are ideal for many tasks, for when a man must think smaller. Though not much research is available, and the application has not been fully utilized to its fullest potential; nano drones are and will continue to emerge as vital assets during emergency management situations, especially during search and rescue. Nano drones have far more potential to serve mankind proudly in everyday scenarios, with improvements in network capabilities and advancements in nano-battery storage; this small innovation has a bright flight path ahead. The concept that bigger is better in the skies is becoming more obsolete, as nano drones prove that smaller is smarter for the future of aviation.

Small unmanned aerial systems (sUAS), or drones are not new terms in the realm of aviation or by the multiple industries that use them to work smarter and safer. However, the advancements in nanotechnology have further increased the capabilities and applications of a new generation of sUAS, called nano drones. Nanotechnology is defined as the science and engineering conducted on the nanoscale, which is about 1 to 100 nanometers. These small-sized and lightweight drones range from the size of soda cans to bumblebees. They range in price from

\$28.88 (Amazon.com, 2020) for the Skyking F001 mini drone, commonly bought for recreational use to approximately \$15,000 - \$20,000 for the FLIR Black Hornet, used by individual soldiers on the battlefield, according to the Army's budget request for the 2019 Fiscal Year (Trevithick, 2019). Like larger sUAS, nano drones are still capable of carrying particular payloads to accommodate the pilot in command; these payloads, including a variety of sensors, cameras, GPSs, and hoist capabilities which are also micro-sized to fit on their specific nano airframes. Nano drones have a bright future in many industries but have found themselves invaluable to two very different consumers out of the gate; the defense industry and every 10-year old child dreaming of flying. They are a top choice for these two parties because they are cheap, quiet, and safe; they prove that smaller is smarter.

The defense industry is always seeking the next best thing. Nations of the world and other defense agencies eagerly became interested in the nimble capabilities of nano drones that sprung from the rapid improvements in nanotechnology. These micro-sized improvements give more soldiers on the battlefield the capability to do recon and surveillance of enemy positions ahead, are less susceptible to anti-aircraft weaponry like larger UAS and can be launched and recovered in hasty situations and hazardous environments, including from an F-18 fighter jet at 460 mph in 14 degrees Fahrenheit temperatures (Jackson, 2018). The Black Hornet by FLIR Systems is just one example of these nano-modern day battlefield assets. According to the Army Times, "The Army awarded a \$40 million contract to FLIR Systems to provide the "Black Hornet" personal reconnaissance system" and though the exact number of drones is not available "publicly reported figures to suggest that could purchase as many as 1,000 drones". This price tag may seem steep for such a small war machine, but these figures are much lower than larger military purchased UAS; especially when you include the reduced cost for training and maintenance.

Like these soldiers on the battlefield, children have always dreamt of seeing the world from above. Though there are many options available for sUAS on shelves at every toy store across the world; Nano drones just seem to catch the eye of every parent making the purchase. They are simply smaller, cheaper, quieter, and safer for their young aviators to learn about the world around them without annoying the neighbor or seriously hurting their siblings during an aerial battle mishap. Small unmanned aerial systems are here to stay and the technology behind them will continue to advance more functional and smaller. Skyfi Labs, a website for parents and children to learn about drones and technology explains that "drones are not only for fun, but a kid can also learn various STEM concepts by handling a drone". These young minds will grow and understand the significant capabilities these micro-sized drones have to offer the world, especially during emergencies and disasters.

The world is an unpredictable place; tragedy and disaster strike without warning every day; challenging mankind to survive, save fellow humans, and recover. It is a tireless effort for emergency management personnel across the world to search through the rubble and unknown dangers that lay ahead of them to save lives. sUAS have become invaluable assets in the heroic missions of saving lives in mankind's hours of need. They have the capability to scan the skies from above with special sensors to detect heat signatures, spot motion, spray fires, and communicate broadcasts with victims. Unfortunately, these sUAS are sometimes just too big to detect the missing or trapped person under the thick tree canopy, in a collapsed building, or beneath the earth in a narrow cave. Nano drones are the future of saving many more lives in these crucial times. Though not enough research is available to convince any reader of their life-saving statistics; it is important to realize their potential in the future of emergency management. In an article by Sean Kane, on the Business Insider, he discusses the "rule of threes", humans

have "three minutes without oxygen, three days without water, three weeks without food". Time is critical when it comes to saving lives. Nano drones can navigate the small spaces of building debris to locate trapped personnel quickly, but also can identify the structural damage to prevent unnecessary accidents to emergency personnel during recovery. A first of its kind, a collision-tolerant drone, specifically designed for inspections and exploration; Elios by Flyability can navigate some of the most inaccessible places (SA). A prime example of a nano drone that will save lives. Though small, nano drones are the smart choice, for when mankind needs a hero.

The research and development of nanotechnology have produced magnificent breakthroughs in the world of UAS, more importantly in Nano drones. However, these small innovations present unique challenges. The small components and configurations require lightweight material, advanced aerodynamics, and efficient energy sources. These challenges are and will continue to be met head-on, not only to give a squad of soldiers a tactical advantage or a 10-year old a fun and cheap view of the world; but also to meet many other obstacles mankind must endure to survive. The cliché that bigger is better, has never been more wrong with the innovative presence of nano drones. Time is critical in our darkest hours; the use of nano drones during emergency events will be vital in saving more lives; clearly proving that smaller is smarter.

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