Researchers design and fly world's largest quadcopter drone

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Manchester’s Giant Foamboard Quadcopter held aloft by some of the researchers and undergraduates who worked on the project. Credit: The University of Manchester

Engineers at The University of Manchester have built and flown the world's largest quadcopter drone. The drone, made from a cardboard-like material called foamboard, measures 6.4m (21 ft) corner to corner and weighs 24.5kg—0.5kg less than the weight limit set by the Civil Aviation Authority.

The innovative design of the drone, dubbed the Giant Foamboard Quadcopter (GFQ), means it is unlike any other in existence. The four arms are formed of a series of hollow box structures and can be easily removed for transportation. There is no record of a purpose-built uncrewed quadcopter (four rotors) of any weight class which is larger than the Manchester vehicle as of the time of writing.

The project started as a curiosity-driven venture to inspire students' creativity in design by utilizing a suitable alternative low-cost material for lightweight aerospace structures that is more environmentally friendly than the usual carbon fiber.

Unlike carbon fiber, low-density sheet materials can be highly recyclable, or even compostable. The researchers hope this demonstration will inspire the next generation of designers to think about sustainability from a completely new perspective.

Dan Koning, a research engineer at The University of Manchester, who led the design and build of the vehicle, said, "Foamboard is an interesting material to work with, used in the right way we can create complex aerospace structures where every component is designed to be only as strong as it needs to be—there is no room for over-engineering here.

"Thanks to this design discipline and after extensive background research, we can say with confidence that we have built the largest quadcopter drone in the world."

While this drone was developed purely as a proof-of-concept exercise, future iterations of this vehicle type could be designed to carry large payloads over short distances or used as a drone 'mothership' in air-to-air docking experiments.

The quadcopter was built from sheets of 5mm thick foamboard, which has a foam core and paper skin. The sheets were laser cut to size and assembled into the 3D structure by hand using only hot melt glue.

Josh Bixler, YouTuber and innovator in remote-controlled aviation is the President of Flite Test, the company that makes the foamboard used in the GFQ.

Commenting on the work, Josh said, "So many times aircraft with advanced features are made of costly materials and we truly believe they don't have to be. Seeing engineers push the limits in such an approachable, yet extravagant way was inspirational and showed that they were truly thinking outside of the box."

GFQ is powered by four electric motors running off a 50-volt battery pack. It also has an on-board flight control system and can fly autonomously.

The first flight took place on 5 July 2023 inside the main hangar at the Snowdonia Aerospace Center during the CASCADE Collaboration Workshop Week where teams from various universities around the UK come together to demonstrate their latest research tech and brainstorm innovation.

Kieran Wood, a Lecturer of Aerospace Systems at The University of Manchester, who piloted the vehicle, said, "The first moments of flight are the make-or-break point for these types of multi-copter drones. There are many hundreds of things that you must get right. If everything

has been designed and built well, we expect success, but any problems will become very apparent in a rapid unscheduled disassembly on the first take-off."

The project builds on the previous success of an equally large fixed-wing foamboard aircraft in 2022. Following this, a student society was created at the University specifically to focus on developing lightweight, large scale foamboard Unmanned Aerial Vehicles (UAVs).

Over the last year, a team of undergraduates helped build and test various critical sub-components of the structure.

Bill Crowther, a Professor of Aerospace Engineering at The University of Manchester, said, "Working with foamboard provides a unique learning opportunity for students to experiment with innovative structural designs. Although the material is strong for its weight, it requires significant engineering skill to exploit its structural potential. Ultimately, with this design you are holding up 25kg of aircraft with just a few strategically placed pieces of paper—that's the art of the possible."

The team are now looking to optimize the design of the Giant Foamboard Quadcopter further.

Dan Koning added, "The lessons we've learned from this pathfinder vehicle should help us add a few more meters to the next one. But to go 50% bigger, you've got to get 100% smarter."

Provided by University of Manchester