Students build Singapore's first personal flying machine

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A team of eight engineering students from the National University of Singapore (NUS) have successfully built Singapore's first personal flying machine, dubbed Snowstorm. Comprising an intricate design of motors, propellers and inflated landing gear set within a hexagonal frame, Snowstorm is an electric-powered aircraft capable of vertical take-off and landing that can be controlled by a single person seated within it.

The NUS team envisions this as a clean and simple way to realise our dreams of flying.

The personal flying machine was built over a one-year period, under the auspices of FrogWorks, a collaboration between NUS Faculty of Engineering's Design-Centric Programme (DCP) and the University Scholars Programme (USP). FrogWorks engages students in the study, design and construction of clean leisure craft, a rapidly growing segment of green technology. Previous FrogWorks projects include the conversion of a sport motorcycle and a yacht from petrol to electric propulsion.

Personal flight – from fantasy to reality

In its current prototype, the personal flying machine can bear the load of a single person up to 70kg for a flight time of about 5 minutes. Rather than a mode of transportation, the team envisions this more as an electric aircraft for personal recreational use in a large indoor space, to satisfy one's desire to fly freely.

"A common trope in popular science fiction is the projection of humans flying on our own – think the Jetsons, or even Back to the Future. NUS' Snowstorm shows that a personal flying machine is a very real possibility, primarily as a means to fulfil our dreams of flying within a recreational setting," said Dr Joerg Weigl, one of two supervisors of the project, who is from the Design-Centric Programme at the NUS Faculty of Engineering.

Snowstorm's features and capabilities

The NUS team spent two semesters designing and building the flying machine, combining their skills and expertise across different fields of

engineering such as computer engineering, electrical engineering and mechanical engineering. Aside from the construction of the physical frame, the students also designed and implemented the craft's electronic control and stabilisation system, a pilot safety system as well as an electric energy management and supply system where the three batteries that power the craft can function independently in the event any of the batteries malfunction.

The electric flying machine sports 24 motors, each driving a propeller of 76cm diameter with 2.2kW of power. Its hexagonal frame is made up of anodised aluminium beams, carbon fibre plates and tubes with Kevlar ropes. The pilot seat is positioned at the centre of the machine, its weight supported by six landing gear legs, the bottom of which is an inflated ball that adsorbs shock when landing. Three independent rechargeable lithium batteries sets provide a total power of 52.8kW.

To ensure pilot safety, the seat is installed with a five-point harness that secures the pilot to the centre of the machine. The flight control system allows the pilot to adjust thrust, pitch, roll and yaw of the craft. In addition, Snowstorm provides a variety of automated flight modes familiar to operators of Unmanned Aerial Vehicles (UAVs), including altitude hold, loiter and position modes. For safety, the team has also worked in a separate switch that can be controlled from the ground to end the flight and bring the machine to a landing, should the pilot lose control of the machine.

"Designing and building Snowstorm was a great learning opportunity for us. The toughest part of this engineering challenge was ensuring a good thrust to weight ratio to allow the craft to lift a person into the air. At every stage of our design, we constantly had to balance and consider trade-offs between the types of materials, their characteristics and weight. In some instances, we even 3D-printed parts, such as our landing gear mount, just so we can have a customised and optimal fit," said Mr

Shawn Sim, a third year NUS Engineering student.

The team first tested their design on a smaller 1/6 scale prototype, before proceeding with the massive task of building the current prototype. Using fasteners and non-permanent connections for the beams, the NUS team also designed the flying machine such that it can be dismantled, transported and reassembled easily.

"Recent advances in motors and battery technology has made it possible for us to literally take to the skies," said Associate Professor Martin Henz of the University Scholars Programme and the School of Computing at NUS, who also supervised the project. "The NUS team will continue to fine-tune Snowstorm, working on mechanical safety measures, propeller and motor configurations, and control software and hardware to achieve the high levels of safety, simplicity and performance required for recreational use by the general public," he added. The NUS team hopes the improvements in the coming year will bring Snowstorm closer to commercialisation.

Provided by National University of Singapore