World's Lightest Micro-Flying Robot Built by Epson

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Seiko Epson Corporation ("Epson") today announced that it has successfully developed a lighter and more advanced successor to the FR, the world's smallest and lightest micro-flying robot. Turning once again to its micromechatronics technology, Epson has redefined the state of the art with its FR-II micro-flying robot—the world's new lightest and most advanced microrobot, which also features Bluetooth wireless control and independent flight. The FR-II will be on display at the Emerging Technology Fair, part of the Future Creation Fair that runs from August 27 to 30 at the Tokyo International Forum.

Development of microrobots

Epson has long been engaged in the research and and in the development of applications for their enabling technologies. The FR-II is only the latest chapter in an Epson success story that began with Monsieur, a microrobot that was listed in the Guinness Book of Records as the world's smallest microrobot and was put on sale in 1993. Having made micromechatronics one of its core technologies, the company has since created and marketed several more microrobots in the EMRoS series. April 2003 saw the introduction of the Monsieur II-P, a prototype microrobot that operates on the world's thinnest microactuator (an ultra-thin, ultrasonic motor) and is remote-controllable via a power-saving Bluetooth module. The following November, Epson unveiled the prototype micro-flying robot FR, which featured two ultra-thin, ultrasonic motors driving two contra-rotating propellers for levitation, plus the world's first linear actuator stabilizing mechanism for attitude control during flight.

However, the FR prototype microrobot's flying range was limited by the length of the power cord attaching it to an external battery, and although it was radio-controlled, it had to be kept within sight of the operator while flying. Consequently, Epson decided that the next step was to extend the flying range by developing fully wireless operation paired with independent flight capability. The main issue to be tackled with regard to wireless flight was the need to combine lighter weight with greater dynamic lift. Epson made the robot lighter by developing a new gyro-sensor that is a mere one-fifth the weight of its predecessor, making it the world's smallest and lightest gyro-sensor. Also helping to shed weight is the high-density mounting technology used to package the microrobot's two microcontrollers including the Epson-original S1C33-family 32-bit RISC. Dynamic lift was boosted 30% by introducing more powerful ultra-thin ultrasonic motors and newly designed, optimally shaped main rotors. As for the challenge of independent flight, Epson brought its many years of micromechatronics experience to bear in realizing the development of a linear actuator with faster response time and a high-precision attitude control mechanism, and a flight path control and independent flight system (primarily for hovering).

To top it off, Epson added an image sensor unit that can capture and transmit aerial images via a Bluetooth wireless connection to a monitor on land, and they also devised two LED lamps that can be controlled as a means of signaling. Epson was assisted by Chiba University's Nonami (Control and Robotics) Laboratory in developing the control system for independent flight. The company also received advice on the rotor design from the Kawachi (Aeronautics and Astronautics) Laboratory at the University of Tokyo.

The key concept behind Epson's R&D efforts in micro-flying robots has been to expand the horizons of microrobot activities from two-dimensional space to three-dimensional space. Now, with the successful implementation of Bluetooth communications and independent flight in the FR-II, Epson has literally added a new dimension to microrobotics while greatly expanding the potential range of microrobot applications by incorporating image capture and transmission functions. At the Emerging Technology Fair, the FR-

II micro-flying robot's features are expected to be showcased in artistic aerial performances. Epson hopes to gain feedback from visitors at this exhibit that may be useful as the company strives toward further progress in developing original micromechatronics technologies and applications.

General specifications

1. Power: 4.2 V
2. Power consumption: 3.5 W
3. Dimensions
Diameter: About 136 mm
Height: About 85 mm
(Note) The FR-II is slightly larger than the FR, which remains the world's smallest micro-flying robot.
4. Maximum lift: About 17 g/f
5. Weight: 8.6 g (total weight without battery), with battery: 12.3 g
3.7 g (battery)
2.9 g (rotary actuator unit)
0.6 g (linear actuator unit)
3.1 g (control circuitry)
2.0 g (frame)
6. Flight time: About 3 minutes

Other microrobots

Last month The Australian National University has demonstrated world's smallest autonomous submarine.The Serafina is 40 centimetres long, with five propellers and a plastic hull crammed with rechargeable batteries and circuitry. The craft is able to travel at a relatively fast underwater speed of one metre per second. The Serafina has been designed to be autonomous. It can be programmed in advance, and will be sufficiently strong to be dropped from the side of a ship. The team aim to develop the Serafina to be able to travel to a depth of between 3000 and 5000 metres, and to be flexible enough to carry a range of sensors useful in undersea exploration and oceanic monitoring.