Hardware Article

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PII: S2468-0672(17)30071-8
DOI: https://doi.org/10.1016/j.ohx.2017.10.003
Reference: OHX 16

To appear in: *HardwareX*

Please cite this article as: J-L. Liardon, L. Hostettler, L. Zulliger, K. Kangur, N.G. Shaik, D.A. Barry, Lake Imaging and Monitoring Aerial Drone, *HardwareX* (2017), doi: https://doi.org/10.1016/j.ohx.2017.10.003

Lake Imaging and Monitoring Aerial Drone

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Submitted to *HardwareX*, 26 June 2017, revised 16 October 2017

Abstract

We describe the development of a BVLOS (Beyond Visual Line-Of-Sight) model aircraft (UAV). The broad design requirements included (i) fuselage capable of accommodating an imaging package or other instrumentation, (ii) suitability for over-lake BVLOS authorization in Switzerland, (iii) capability of land or water take-offs/landing, (iv) at least 90-min flight autonomy, (v) modularity of the imaging package and (vi) real-time IR/RGB imagery. Requirement (i) was to ensure an aircraft amenable to future developments. Requirements (ii)-(iv) were driven by the goal of improving estimates of lake surface energy fluxes, since such fluxes have a major impact on long-term lake temperatures and hence ecological status. Requirement (v), in conjunction with (i), allows the UAV to be adapted to other imaging applications. The real-time imagery requirement (vi) permits modifications of on-going missions to map areas of specific interest as they are detected. The prototype UAV produced to satisfy these characteristics was built on the twin-motor My Twin Dream (MTD) aircraft, which has a 1.8-m wing span airframe and a spacious fuselage. The legal authorization necessitated, where feasible, hardware redundancy as well as installation of a parachute system. Continuous communication between the ground station and UAV is provided by the LTE cellular telephone network. The UAV communication is handled by an on-board Linux computer, which is also responsible for control of the imagery package. The avionics involved modifications of the open-source APM autopilot software and the associated ground control station. A key modification was to support a custom-built emergency recovery system, which is triggered by loss of a heart-beat signal from the autopilot. The MTD airframe was modified to accommodate the system electronics and imaging hardware. Results from test flights over Lake Geneva demonstrate the ability of the aircraft to produce imagery data.

Keywords: 4G Network, Mobile, Streaming, Telemetry, UAV, Imagery, Autonomous aircraft, LIMONAD, Infrared, RGB, Parachute, BVLOS, IR

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