Small UAS identification and tracking in Denmark

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Publication date:
2017

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Introduction

In 2015 the Danish Civil Aviation Authority (CAA) initiated a project on small UAS (sUAS) identification and tracking with the SDU UAS Center at the University of Southern Denmark (SDU) as the lead partner. The aim of the project is to develop prototypes of drone devices and infrastructure and to validate the implementation feasibility in a field experiment involving key stakeholders including commercial sUAS operators and the authorities. The preliminary results of this work have been published in a technical report [1]. The purpose of this paper is to provide a resume of the results to facilitate an assessment of the possibilities for future collaboration.

Danish legislation

Use of small drones in Denmark is governed by the Danish aviation law [2] revised in 2016. The law is supported by a regulation for sUAS flight in urban areas [3] permitting professional flights only by certified drone pilots, and a regulation for sUAS flight outside urban areas [4] permitting also recreational sUAS flights. In urban areas flight plans must be submitted 24 hours in advance to the Danish Police for evaluation. To effectively enforce the legislation and deal with an increasing number of contacts from citizens concerned about observed sUAS flights, the police wishes to add to the flight plans the ability to identify and track sUAS flights. It has yet to be determined if the system will be applied only to sUAS flights in urban areas or everywhere. In January 2017 the CAA announced that EU regulation is expected to replace the Danish legislation for small drones within 1-2 years.

System architecture

The Danish UAS Traffic Management (UTM) prototype system architecture is shown in figure 1. At the current stage the UTM system communicates with DroneID beacons, records flight logs and shows graphical representations of current and historical sUAS flights along with static no-fly zones. In development are features such as: Information about nearby manned aircrafts at low-altitude; providing position and state information to sUAS about other nearby sUAS; providing warnings and alerts to the sUAS pilot in case of a no-fly zone breach.

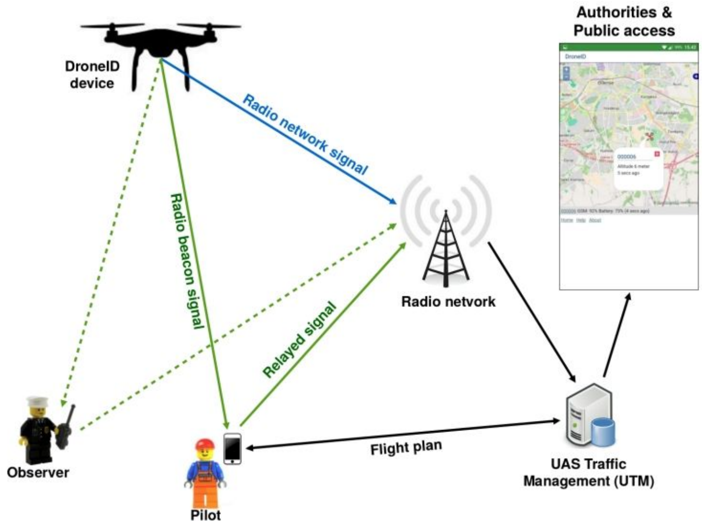


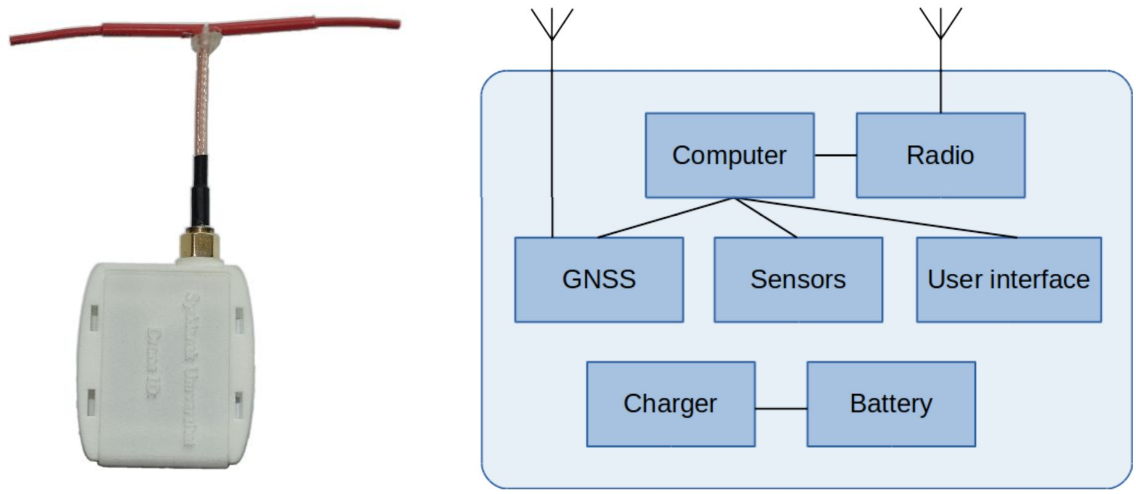
Figure 1: The Danish prototype UTM system architecture. sUAS' are equipped with a DroneID device which communicates with a UTM server either directly via a radio network infrastructure (depicted as a blue line) or via a local radio beacon received by the pilot and other stakeholders nearby the sUAS and relayed to the UTM (depicted as green lines).

DroneID device

It is expected that the DroneID functionality will in the future be embedded in the sUAS technology by manufacturers following open standards, however for experiments and also for sUAS not having this technology, an external DroneID device is needed. For sUAS identification and tracking in urban areas it is expected that a network infrastructure will be used for communication. Outside urban areas it is expected that local radio beacons will be used due to the smaller Size, Weight and Power (SWaP) and lower cost, which may be more applicable to sUAS used for recreational purposes. In this work devices using both technologies have been developed and tested.

Local radio beacons have been developed and tested by commercial partners in the project: Reseiwe A/S has developed a resilient Wifi link (ReWiLink [5]) technology based on existing protocol standards which is applicable to even microdrones due to the small SWaP. Scandinavian Avionics A/S has developed UAV-ID [6], a sUAS transponder based on the VDL Mode 4 protocol, which is more applicable to larger sUAS and requires dedicated ground receiver unit.

SDU has developed a DroneID device (figure 2a) based on GPRS 2.5G. Expectedly 5G will be used for final devices, but focus has been on early implementation and field experiments with the UTM system, and GPRS has proven to be problem-free in the experiments performed until now. The DroneID block diagram is depicted in (figure 2b). Due to concerns about liability and the manufacturer's warranty in case of a malfunctioning sUAS with a DroneID device installed, the device is completely independent of the sUAS' sensors and power supply. It transmits updates containing sUAS identification, time, GNSS position, altitude, battery voltage and GPRS Received Signal Strength Indicator (RSSI) to the UTM system at a rate of 0.2-1 Hz. The dimensions are 38 x 46 x 19 mm (housing), the total weight is 27g, battery lifetime is 2-3.5 hours depending on the update rate. A single prototype unit materials cost is approximately USD 100.



(a) (b)

Figure 2 (a): Image of DroneID device v1 with an external GNSS dipole antenna. (b): DroneID block diagramme. The DroneID v1 device contains a Li-Po battery and charging circuit for 5V (micro-USB), IMU, barometric sensor, GPRS modem with built-in GPS, one button user interface, two LED's for user feedback.

Field experiment

A field experiment was conducted (figure 3) in the Fall 2015. 10 professional drone pilots were using a DroneID device during their regular flights during a 30 day period. In addition to the data recorded by the DroneID device, the pilots filled out an online questionnaire concerning details of the flight and their observations and experiences from using the DroneID device.

Figure 3: Field experiment kickoff workshop for professional sUAS pilots learning how to install and use the DroneID device as part of their sUAS flights.

During the 30 day field experiment two workshops were held for key stakeholders including personnel from the CAA, the Danish ANSP, the Danish National Police, the Danish Emergency Management Agency (DEMA) and the Danish Defence. At the workshops tentative findings from the development and field experiment were conveyed to the participants, and feedback was provided on the applicability in each sector.

Conclusion

In this work a system for small UAS identification and tracking in Denmark has been proposed. DroneID device prototypes using network infrastructure and local radio beacons have been developed and tested against an early UTM system prototype. A field experiment was conducted where 10 professional pilots used a DroneID device during sUAS flights for 30 days.

Future work

Currently a DroneID v2 device is being developed and tested. The GPS is replaced by a GNSS module with internal antenna. The total weight is lowered to about 20 g and the size is reduced as well. More features such as enhanced signal processing and power saving, fallback to SMS in case of low GPRS coverage etc. are being developed. In the Spring and Summer 2017 a new field experiment will be conducted involving more professional pilots over a longer time period focusing primarily on operational and usability aspects while still testing the new device and updated infrastructure.

References

[1] http://droneid.dk/download/DroneID_Report_October_2016.pdf
[2] https://www.retsinformation.dk/Forms/R0710.aspx?id=181630
[3]http://www.trafikstyrelsen.dk/~/media/Dokumenter/08%20Luftfart/04%20Luftfartserhverv/Order%20on%20drone%20operations%20in%20built-up%20areas.pdf
[4] http://www.droneregler.dk
[5] http://reseiwe.com/wifi-for-uavs
[6] http://www.scanav.com/fileadmin/files/Flyers/SAFlyer_UAV-ID.pdf