Aquadrone : geo-tracking and collecting environmental data from an underwater remotely operated vehicle

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Abstract

Backed by the INSIDE cluster[1], the French Biodiversity Agency invests in Open Source technologies. The way software projects and public market are led strongly evolved with agile approaches and interoperable systems. The AFB collects environmental data for prominent data repositories, such as the French Information System for Water and the European WISE[2]. The scope of data about lake and rivers is broad: bathymetry, physico-chemistry, hydromorphology, biology, quantity (dsicharge and low flows), real-time temperatures.

As the methods for collecting data are widely diversified, field officers are assisted with modular and specially designed technical answers[3]. Thanks to the spread of onboard electronics and the efficiency of Open Source libraries, the agency was able to develop a low-cost underwater ROV for monitoring and scientific purpose, guided using cable and video. The base vehicle is the BlueROV2 by BlueRobotics®.

The *Aquadrone* project tackles two main issues: (1) geo-tracking the drone at any time, even when the drone is underwater, (2) real-time data transmission and visualization for the experts on shore.

Two technologies were used to face the first challenge (1): when floating to the surface, a GPS RTK REACH (Emlid®) signal is received. The geographical location is known within a range under 20 cm. During the diving stage, the internal inertial measurement unit (IMU Pixhawk®) provides moving information. Then, an integration algorithm simulates the drone path on

1 The INSIDE RDI research cluster gathers FBA and BRGM software developers and architects : http://www.pole-inside.fr/en, http://www.pole-inside.fr/wild.

2 The web portal http://www.eaufrance.fr/ is the main entrance for the Information System for Water (SIE). The repository http://www.data.eaufrance.fr/ is a major actor of governmental opendata. The European Commission gathers members data in the WISE system (http://water.europa.eu/), to which AFB is a partner and a contributor.

3 Workshops about geo-tracking, teledetection and ROV are staged by AFB (http://www.onema.fr/avancees-apports-et-perspectives-de-la-teledetection-pour-la-caracterisation-physique-des-corridors). In the marine protected areas, *SURVEILLAMP* project (http://www.aires-marines.fr/Connaitre/Ecosystemes/Connaissance-et-suivi-des-ecosystemes-marins-par-la-technologie) explores and senses the environment.

map. An accuracy gauge characterizes the geo-tracking deviation, and indicates the threshold for which a new surface GPS recalibration is needed. Integration tests led by the Agency indicate a 20 to 50 cm accuracy when the trajectory is linear and an underestimate of 1/7 to 1/6 of the curvilinear distance during tight turns.

Aquadrone took up the next challenge (2) through two steps. Throughout the diving, sampled data is transmitted to a master computer and stored in a PostgreSQL database. First, as data is collected, client computers dynamically display analysis through a QGIS plugin. Estimates from the IMU are used for geo-tracking. Secondly, when the drone is able to recalibrate its location using GPS, a two-way algorithm reassesses the whole dataset positions. On the shore, the display is dynamically shifted with accurate data, allowing the operators to react to the new survey. The precise geo-tracking helps to complete site monitoring and to avoid post-analysis and new boat-launches.

A six-month academic work by ESIPE[4] engineer students provided a fully operational solution: choice of technical solution, technical changes and adaptations of the tools, IMU geo-tracking, data transmission and real-time visualization design and programming, location algorithms (including IMU simulations, estimates and location reassessment).

This work provided new outlooks for the Agency: exploring not easily accessible rivers, better safety by avoiding human diving for minor statements, collecting data using automatic drone behaviors, adding sensors (today, only temperature and depth are collected), *in situ* big data analysis (including sonar surveys using PostgreSQL and Java point clouds).

Aquadrone main page is located at : http://www.pole-inside.fr/aquadrone[5] (github sources, on-line technical specifications).

Keywords

(Underwater) remotely operated vehicle, Monitoring sensors, Real-time data collection and treatment, (Multi-tools and underwater) geo-tracking, Field survey, Water quality.

Topic category (one of and checked box is ☑)

Family 1: FOSS4G applications, application domains and ecosystems
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☐ Strategic application domains: land management, crisis/disaster response, smart cities, climate change
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Family 3: Geospatial Data

4 ESIPE *(Ecole supérieure d'ingénieurs Paris-Est Marne-la-Vallée*), or ESIP-MLV, proposes each year a *last project* to its students : http://esipe.u-pem.fr/filieres/informatique-et-geomatique/ and http://esipe.u-pem.fr/filieres/informatique-et-reseaux/.
5 English version (http://www.pole-inside.fr/en/aquadrone) will be set in April 2017.

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☐ Certification for FOSS4G
Family 5: New Trends
☐ IoT
☐ Indoor mapping
☑ UAV's.
☐ Cloud based geo-applications
☐ Location privacy

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