microdrones.com

Case Study

Project AirShield

Description of the Project AirShield and its results in the final demonstration at Falck RISC Rotterdam

---

Version 1.0

Presented by: microdrones GmbH

Profiles: microdrones

microdrones information

microdrones / Partner	microdrones GmbH
microdrones Logo	
Branch	Aero / UAV
Address	Gutenbergstraße 86
ZIP Code, State, City	57078 Siegen, NRW, Germany
Phone number	+49 (0) 271 77 00 38 - 0
Fax number	+49 (0) 271 77 00 38 - 11

Contact name	Douglas DeMaio
Title / Position	Project Management & Technical Support
Phone number	+49 (0)271 7700 38 24
Fax number	+49 (0)271 7700 38-11
E-mail address	info@microdrones.com

Solution group	TU Dortmund University Communication Networks Institute (CNI) University of Siegen Institute for Real-Time Learning Systems (EZLS) University of Paderborn Institute for Computer Application and Integration in Design and Planning (CIK) TU Berlin, Chair for Innovation Economics (LIO) Leibniz Institute for Tropospheric Research (IFT) Institute for Firefighting and Resuce Technology (IFR) microdrones GmbH GIS Consult Gesellschaft für Gerätebau mbH
Solution offering	Prototypic system for real-time pollution hazard analysis
Project name or title	AirShield
Research Field	Flight platforms, swarm behavior, adaptable network topologies, geoinformation theory, atmospheric models, thermodynamics
Keywords	development, lightweight flying robots, on-board sensors, intelligent and autonomous MUAV flock movement, concentration gradients, simulation forecasting, mobile ad-hoc network, between multiple drones and between the flying robots and the ground stations, Internetworking, geo-information, decision support systems, risk analysis, technology acceptance, economic benefit

Project AirShield information:

Name	AirShield | Schutz von Mensch und Umwelt
Logo	AIRSHIELD Schutz von Mensch und Umwelt
Project Support	Funded project by **Federal Ministry of Education and Research, Germany** Federal Ministry of Education and Research
Address	Otto-Hahn-Str. 6
ZIP Code, state, City	44227 Dortmund
Web site address	http://www.airshield.de/index.php

Contact name	Christian Wietfeld
Title / Position	Prof. Dr.-Ing. / Project Leader
Phone number	+49 (0) 231/755-4515
Fax number	+49 (0) 231/755-6136
E-mail address	christian.wietfeld@tu-dortmund.de

Case Study for "**AirShield / RISC**"

Project profile

AirShield is a BMBF funded research project in the field of "Civilian Safety Research" which relates to the protection of vital and sensitive infrastructures and general population from man made threats and natural disaster. This project is part of the program called "Research for the civilian safety" in the field of "Integrated protection system for rescue and security forces".

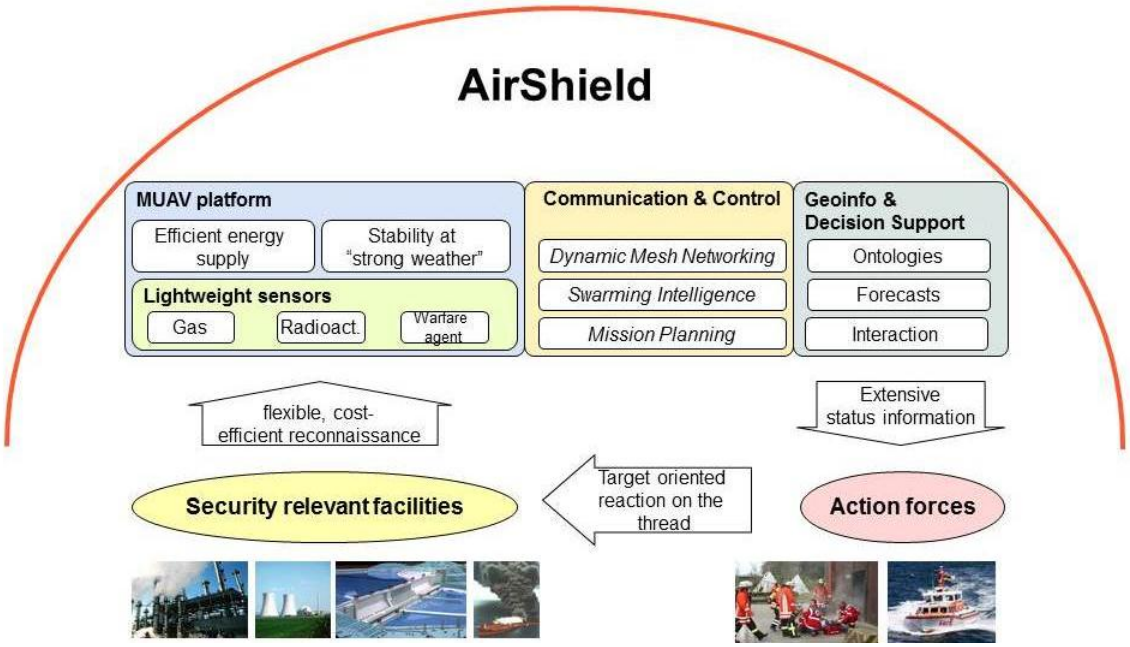

Figure 1 http://www.airshield.de/

In this context, the AirShield project proposes the use of (partly) autonomous flying robots for reconnaissance purpose and aiding in the forecasting and prevention of emergency situations. The mobile MUAV (miniature unmanned aerial vehicles) equipped with lightweight sensors will collect relevant data/information from the incident scene, which will be processed into tangible and actionable information. This information, represented as the visual and/or spatial landscape of the incident scene, will then be relayed to the relevant authority, which is expected to enhance their mission management capabilities and decision process.

Situation, aims and objectives

SITUATION: One of the emerging challenges in managing situations such as fire or gas leakages is the combating and containment of the disaster event. This can be achieved efficiently if the disaster managers are provided with timely and detailed information of the situation not only at ground level but also at greater heights. The AirShield project is mandated to provide critical data by means of aerial surveillance of the disaster area and deliver important information that will be analyzed to devise and implement effective and appropriate action plans.

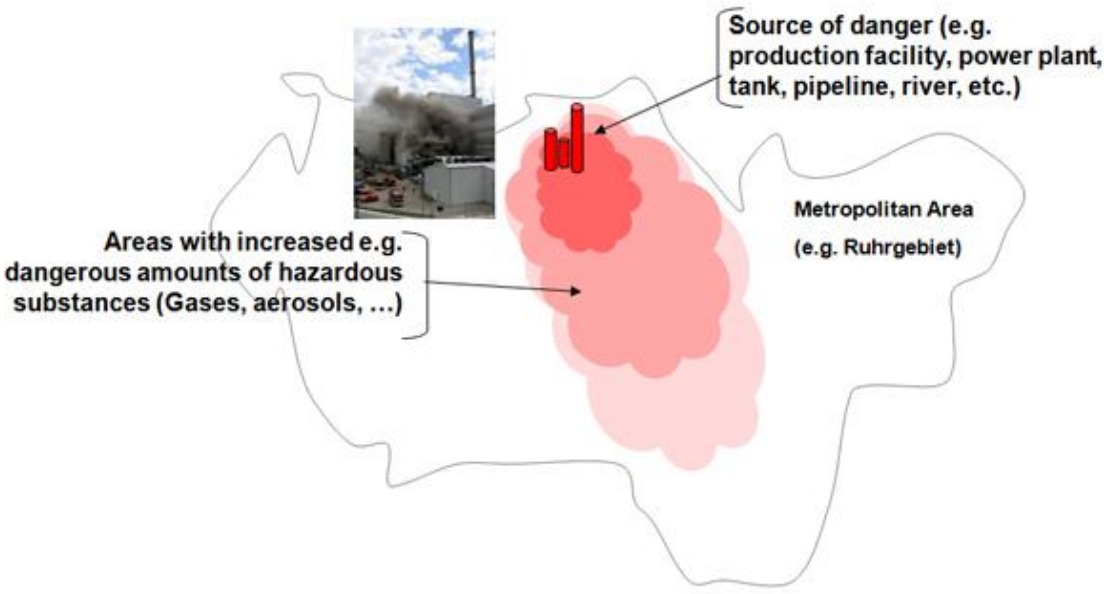

Figure 2 http://www.airshield.de/

At present the fire brigade personnel are provided with special handheld devices that can only measure the concentration of different pollutants at ground level but are unable to survey and quantify the level of contamination carried in the atmosphere by winds and/or ascending columns of smoke. Such a measurement is critical to the safety of outlying communities that may be affected by these aerial pollutants.

In view of the above mentioned challenges a consortium under the aegis of AirShield has been formed. This consortium comprising of three industrial partners, five research institutions and one end user is coordinated by the Communication Networks Institute at TU Dortmund.

AIMS / OBJECTIVES: In order to lead the AirShield project to a successful completion it is necessary to clearly define the objectives for all essential components of the system. The essential challenges are summarized as follows:

1. **MUAV platform**
   High load, Long hours of operation, Stability in bad weather situations

2. **Lightweight sensors**
   Minimum weight, High measurement accuracy despite the miniaturization of the measurement instruments

3. **Communication and operation**
   High reliability of the communication system, Small delay for the transfer of control information, High data rate for the transfer of information in real time

4. **Geoinformation and Decision Support**
   Clear representation of the propagation forecast, Inclusion of geographic data, Inclusion of weather forecasts

Solution & Demonstration of Project Results (Falck RISC)

SOLUTION APPROACH: The three-staged solution approach which was chosen for the realization of the AirShield project can be comprehended by the illustration below:

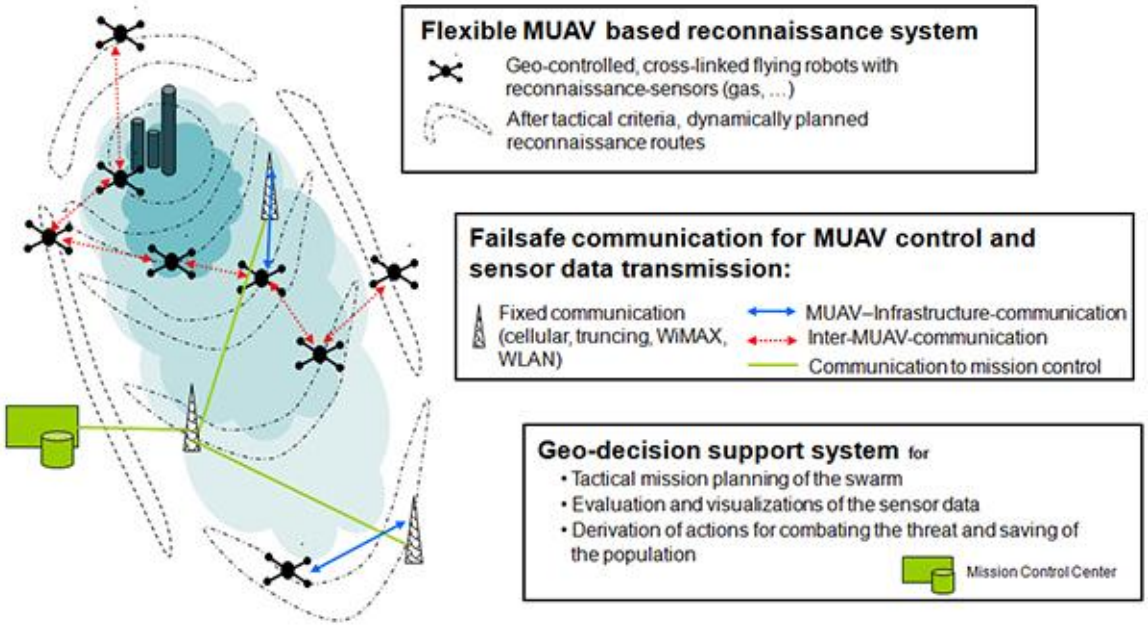

Figure 3 http://www.airshield.de/

The first stage contains the "flying units" consisting of flying robots and gas measurement devices. These flying units move on predefined routes along the concentration gradient of the aerosol and send the acquired measurement data to the ground station at regular time intervals.

The second stage is the invocation of the Geo-decision support system located on ground inside the Mission Control Center (MCC). Here the data received from the drones are evaluated, linked to topological and geographical information and finally presented to the user in a tangible descriptive form, together with additional data.

The connection between the first two stages is characterized by a highly reliable communication system. This on one hand will consist of the so called "Inter MUAV Links" between the individual flying robots of a swarm and on the other hand of "MUAV to Ground Station Links", which will guarantee the communication

of the swarm with the Mission Control Center (MCC). For sustaining both kinds of communication, state-of-art procedures and processes are used for AirShield.

PRACTICAL TEST: The validation of the AirShield system under conditions similar to a real-life mission was the goal of an elaborate test. A delegation of the AirShield team (TU Dortmund, microdrones, University of Siegen, Institute for Firefighting and Rescue technology, University of Paderborn and GIS Consult) travelled to the Rotterdam International Safety Center (RISC), a training ground located on the far edges of the Rotterdam harbor. Because of the remote location it is possible to light up even larges fires with significant smoke emissions without bothering or endangering residents.

For the first time the opportunity arose to emulate major incidents and to evaluate the gaseous pollution sensors and the performance of the MUAV under influence of intense smoke and heat. One aspect of the test was to check the real-time transmission of measurement data coming from the individual sensors to the embedded PC system in the air, down to the communication server on the ground and finally reaching the user interface. Another key aspect was to assess the specific effects of heat stress on the electronic components of the flight platform. For these tests a total of three bins with surface areas of one, five and nine square meters were filled with a liquid combustible and lit up. The burning time of each test was between two and five minutes. Two of the four vehicles that usually constitute the AirShield swarm were used for test flights, one of which had a special suction pump to ingest sample gas from atop of the rotor blade plane.

This test was able to finally prove that the AirShield system is in large parts capable of accomplishing the tasks of the NBC-Scout (cp. German “ABC-Erkunder”) directly alongside the smoke cloud. In proximity to the cloud substantially heightened concentrations of CO and H2S were measured as well as a significant decrease of the oxygen level. The results could be seen in real-time on the system’s graphic user interface. The flight performance of the MUAVs was neither compromised by heat nor smoke particles and stable even inside the smoke cloud. A slight but non-critical increase of temperature in the motor nacelles was recognized not until the end of the test after several minutes of hovering directly above the source of the fire.

Benefits

- The only VTOL MUAV in its class, which has officially passed a fire test
- Especially tested for the use in extreme areas of applications
- Reliable VTOL MUAV for the use of public authorities (Police / Fire / Emergency Services)
- Feedback from sb4-1200 specialized flight platform to series production
    - md4-1000 motor functioning at extreme heat conditions
    - md4-1000 functioning at extreme heat conditions

Products and services which got used

- sb4-1200 (microdrones GmbH)
- GfG Microtector II G460 (Gesellschaft für Gerätebau mbh)
- custom built ARM microcomputer with mission control (Uni Siegen)
- Gumstix microcomputer with mesh network communication control (TU Dortmund)
- AirShield ground system (GIS Consult / Uni Paderborn)

Photos