Emergency-response drones to save lives in the digital skies

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SAFIR-Med Uncrewed aircraft in the sky above the headquarters of the Port of Antwerp-Bruges. Credit: © Helicus - Geert Vanhandenhove, Rik Van Boxem, 2022

Uncrewed aircraft responding to fire and medical emergencies will be used to save lives—if digitalized air-traffic control can help them navigate safely in the skies over Europe.

In a city in the future, a fire breaks out in a skyscraper. An alarm is triggered and a swarm of drones swoops in, surrounds the building and uses antennas to locate people inside, enabling firefighters to go straight to the stricken individuals. Just in the nick of time—no deaths are recorded.

Elsewhere in the city, drones fly back and forth delivering tissue samples from hospitals to specialist labs for analysis, while another rushes a defibrillator to someone who has suffered a suspected cardiac arrest on a football pitch. The patient lives, with the saved minutes proving critical.

At the time of writing, drones have already been used in search-and-rescue situations to save more than 880 people worldwide, according to drone company DJI. Drones are also being used for medical purposes, such as to transport medicines and samples, and take vaccines to remote areas.

Drones for such uses are still a relatively new development, meaning there is plenty of room to make them more effective and improve supporting infrastructure. This is particularly true when it comes to urban environments, where navigation is complex and requires safety regulations.

Flying firefighters

The IDEAL DRONE project developed a system to aid in firefighting and other emergencies to demonstrate the potential for using swarms of uncrewed aerial vehicles (UAVs) in such situations. Equipped with antennas, the drones use a radio-frequency system to detect the location of "nodes"—or tags—worn by people inside a building.

Making use of an Italian aircraft hangar, the tests involved pilots on the ground flying three drones around the outside of a building. The idea is

that the drones triangulate the position of people inside where their signals intersect, as well as detecting information about their health condition. The details can then be mapped to optimize and accelerate rescue operations, and enhance safety for firefighters by allowing them to avoid searching all over a burning building without knowing where people are.

"You create a sort of temporary network from outside the building through which you can detect the people inside," said Professor Gian Paolo Cimellaro, an engineer at the Polytechnic University of Turin and project lead on IDEAL DRONE.

"By knowing how many people are inside the building and where they are located, it will optimize the search-and-rescue operation."

He added: "A unique characteristic of this project is that it allows indoor tracking without communication networks such as Wi-Fi or GPS, which might not be available if you are in an emergency like a disaster or post-earthquake situation."

There are some challenges in terms of accuracy and battery life, while another obvious drawback is that people in the building need to already be wearing trackers.

However, said Prof. Cimellaro, current thinking is that this can be unintrusive if tags are incorporated in existing technology that people often already carry such as smartwatches, mobile phones or ID cards. They can also be used by organizations that mandate their use for staff working in hazardous environments, such as factories or offshore oil rigs.

Looking beyond the challenges, Prof. Cimellaro thinks such systems could be a reality within five years, with drones holding significant

future promise for avoiding "putting human lives in danger."

Medical networks

Another area in which drones can be used to save lives is medical emergencies. This is the focus of the SAFIR-Med project.

Belgian medical drone operator Helicus has established a command-and-control (C2C) center in Antwerp to coordinate drone flights. The idea is that the C2C automatically creates flight plans using artificial intelligence, navigating within a digital twin—or virtual representation—of the real world. These plans are then relayed to the relevant air traffic authorities for flight authorization.

"We foresee drone cargo ports on the rooftops of hospitals, integrated as much as possible with the hospital's logistical system so that transport can be on demand," added Geert Vanhandenhove, manager of flight operations at Helicus.

So far, SAFIR-Med has successfully carried out remote virtual demonstrations, simulations, flights controlled from the C2C at test sites, and other tests such as that of a "detect-and-avoid" system to help drones take evasive action when others are flying in the vicinity.

The next step will be to validate the concepts in real-life demonstrations in several countries, including Belgium, Germany and the Netherlands. The trials envisage scenarios including transfers of medical equipment and tissue samples between hospitals and labs, delivery of a defibrillator to treat a cardiac patient outside a hospital, and transport of a physician to an emergency site by passenger drone.

Additional simulations in Greece and the Czech Republic will show the potential for extending such systems across Europe.

SAFIR-med is part of a wider initiative known as U-space. It's co-funded by the Single European Sky Air Traffic Management Research (SESAR) Joint Undertaking which is a public-private effort for safer drone operations under the Digital European Sky.

Making rules

Much of the technology is already there for such uses of drones, says Vanhandenhove. However, he highlights that there are regulatory challenges involved in drone flights in cities, especially with larger models flying beyond visual line of sight (BVLOS). This includes authorizations for demonstrations within SAFIR-Med itself.

"The fact that this is the first time this is being done is posing significant hurdles," he said. "It will depend on the authorizations granted as to which scenarios can be executed."

But regulations are set to open up over time, with European Commission rules facilitating a framework for use of BVLOS UAVs in low-level airspace due to come into force next January.

Vanhandenhove emphasizes that the development of more robust drone infrastructure will be a gradual process of learning and improvement. Eventually, he hopes that through well-coordinated systems with authorities, emergency flights can be mobilized in seconds in smart cities of the future. "For us, it's very important that we can get an authorization in sub-minute time," he said.

He believes commercial flights could even begin within a couple of years, though it may not be until post-2025 that widely integrated, robust uncrewed medical systems come into play in cities. "It's about making the logistics of delivering whatever medical treatment faster and more efficient, and taking out as much as possible the constraints and

limitations that we have on the route," said Vanhandenhove.

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