UTILIZATION OF TESTING TOOLS

EARLY FOREST FIRE DETECTION USING UNMANNED AERIAL VEHICLES

The use of aircrafts for early forest fire detection and prevention is not a new idea. According to several sources and, aerial firefighting began around 1920 with the first attempts for dropping water from aircrafts onto ongoing forest fires. In these early years for the aviation, the use of planes for actual extinguishing of fires was not so successful, so the focus turned on their use for forest fire detection. In the decades after World War II, the use of aircrafts for forest fighting was resumed and by the late 1960s many airplanes and helicopters were actually involved in it.

The use of aircrafts for forest fighting however has proven to be expensive and also dangerous, as the aircraft pilots are pushed to their limits and are expected to fly in dangerous conditions and extremely close to the fires. Numerous accidents with firefighting aircrafts were recorded throughout the years and this has raised the public alert about their reliability and the actual benefits from their use. The recent advances in the development of the unmanned aerial vehicles (UAVs) provided the possibility to use them in the fight against the forest fires as a replacement of the piloted aircrafts.

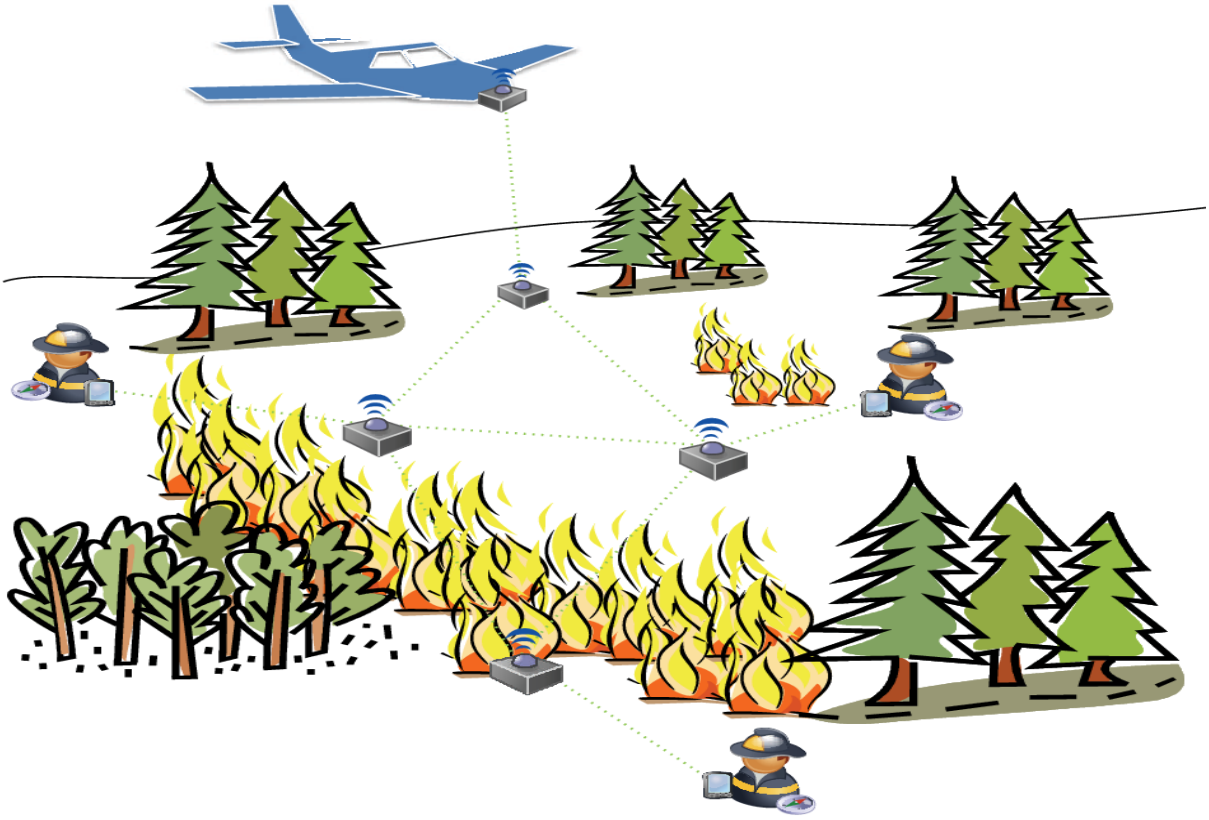
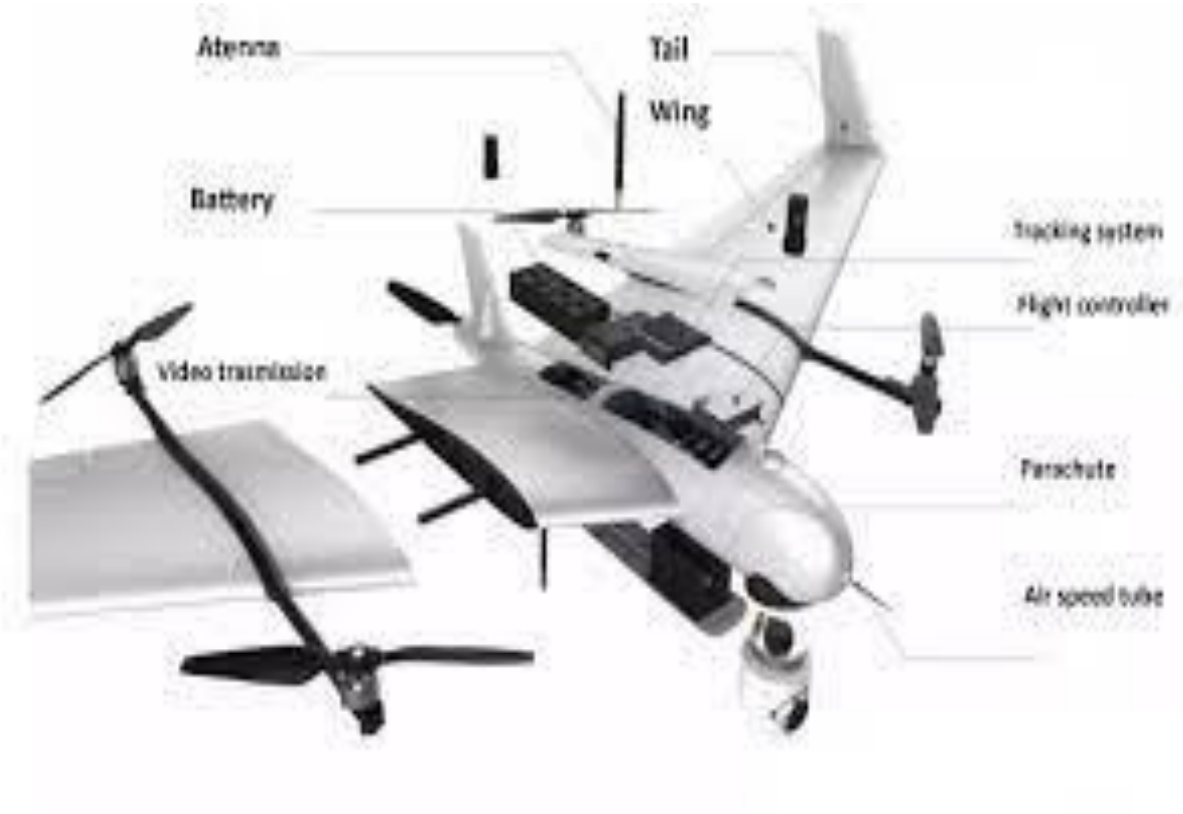


FIGURE 1: EIDOS architecture.

ALTi Transition vertical take-off and landing fixed wing UAV and its ground control station

The terrain of the Nature Park Rusenski Lom involves a steep canyon along the Rusenski Lom River covered by very dense forest vegetation. The altitude variates from the ground level (0 meters) at the riverbed to 150-170 meters at the highest points of the canyon. This makes the location very difficult for observation using ground cameras, as their placement should be on higher grounds to provide wider overview of the area. The installation of the cameras is however allowed only in specific areas of the park, which are outside of the protected habitat zones and this makes their use impossible.

As a last resort, the Directorate of the Nature Park will install just one camera at the rooftop of a local facility. To provide an overall overview of the park and to observe its difficult terrain, we have decided to use a fixed wing endurance UAV. After a careful market analysis,we have selected the ALTi Transition VTOL UAV.The dimensions of the aircraft are 3000 mm wingspan, 2300 mm length and 525 mm height and its maximum take-off weight is 16 kg, which allows it to carry several different types of payload simultaneously. Its flight time is from 8 to 10 hours with average sized payload, which allows it to be used for long observations of the targeted forest areas. The drone is equipped with a NightHawk 2 EO/IR camera with 20x zoom and thermal resolution of 640x480.



The DJI Matrice 210 RTK rotary wing drone with its dual downwards gimbal with mounted IR (XT) and regular (X5S) cameras

The Matrice 600 Pro drone is larger and can carry up to 5 kilograms of additional payload, which make it suitable as a development platform. Unlike it, the Matrice 210 RTK is more sophisticated and is equipped with a dual gimbal with one IR and one standard/zoom camra. The RTK extension, allows this drone to be precisely localized and also to precisely pinpoint any location on the ground. Another huge advantage of the Matrice 200 series of drones is the fact that they are IP 43 certified, which means that they can withstand humidity and can fly in foggy or rainy conditions. The use of both rotary wing UAVs will provide the possibility for close inspection of the potential forest fire location and to perform the initial assessment of the situation.

The implementation of the system is currently ongoing and is performed under the supervision of several university professors. Besides them, several PhD students and more than a dozen regular Bachelor and Master students are or will be involved in the project. All of them will participate in two training events with topics about the characteristics of the UAVs and their application areas. The drones will be assembled, tested and piloted by the university staff and the PhD students, but all interested students will be allowed to study and test them. Following the successful implementation of the system we hope to collect significant database with images, which will then be used by the students to reconstruct and create ortho-photo images, digital surface models and 3D maps of the targeted areas.

EARLY FOREST FIRE DETECTION USING LORAWAN SENSOR NETWORKS AND DEVICES

The Long Range (LoRa) digital wireless communication technology and the closely related LoRaWan networks are known for their longrange communication capabilities and are extremely suitable for sensor and telemetry applications. The improved range makes these network also suitable for many new applications, including forestfire detection, environmental sensing and long term air-quality analysis.

In order to provide LoRaWAN connectivity in the region of Ruse (Bulgaria), the Department of Telecommunications, at the University of Ruse, has established a network of different LoRaWAN gateways. Two types of gateways were installed – IMST iC880A concentrators, which were mounted on Raspberry Pi 3 Model B+ microcomputers and Pycom LoPy modules with extension boards.

The gateways were able to receive data from more than 6000 LoRaWAN devices. Driven by the ambition to fully utilize this network, several students, under the supervision of their university professors, started the development of small-sized sensor stations equipped with sensors for temperature, humidity and atmospheric pressure. A further improvement and upgrade of these stations is underway and will provide them with sensors for analysis of different gasses and sensors for measurement of particle matter. This upgrade will make the stations suitable for both early detection of the forest fires and for post-fire damage assessment in terms of the released pollutants in the atmosphere.