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LUAV'S ARE THE RIGHT APPROACH FOR SURVEILLANCE CIVIL MISSIONS

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Abstract: Surveillance missions are among the most needed ones in monitoring the environment and in modern disaster management mechanisms emergency situations. Environmental monitoring is part of the management of reserved areas and nature parks. In pre-disasters situations, environmental emergency organizations need the most possible information brought right from the center of the ground evolving processes. The information a LUAV (Light Unmanned Aerial Vehicle) can get or measure through its sensors is various. In a flight above the endangered area, one may get visual, IR and/or thermal images, take air samples and measure toxic emissions or radioactivity levels. For people dealing with a HAZMAT operation, having accurate and most complete information can be a matter of life and death situation. Also, whether a disaster occurs naturally or caused by manmade event, a quick response is then critical for all the implied actors. Being able to quickly get an overview of the extent of injuries, damage, existing and potential hazards along with a live map of the access and exit points allows you to prioritize resources in order to start effectively managing the disaster site. All the information obtained without jeopardizing people plays an important role in modern disaster management and helps organizations identify and prevent further disaster risks.

***Keywords**: Light Unmanned Aerial Vehicle, environmental monitoring, disaster management*

1. INTRODUCTION

In civil sector, since the military has demonstrated reliability and usefulness of the UAVs, the Unmanned Aerial Vehicles have already outlined many potential uses[1]:

Thus, for the interior administration, the UAVs have shown their value for actions such as monitoring the occurrence of emergency/dangerous situations and monitoring their evolution, maintaining public order, border security, coastal protection and monitoring traffic.

In the fight against fires in large areas (forests, grasslands) the UAVs have shown their value for early detection of fires - in areas far from human settlements, as in forests or in hights, early detection of other major accidents, finding survivors in inaccessible areas (for example, in the mountains or flooded areas).

In the energy sector, UAVs began to be used for monitoring the infrastructure and pipelines for oil and gas distribution and for monitoring the distribution networks for electricity.

In agriculture, or in wood harvesting and fishing, UAVs are being used on an increasingly wide scale for monitoring natural environment, spreading of chemicals in agriculture, or for natural resource monitoring, in order to optimize their use, as for protection of fish ponds.

In applications of land surface observation and remote measurements of the environmental parameters, UAVs are appreciated for mission as climate monitoring, aerial photography, maps and cadastral surveys for the construction of bridges and roads in inaccessible areas, monitoring the occurrence of seismic events, aerial archeology.

In Fig. 1 may be seen a faster trend of growth for the civil sector, compared with the military one. As a result, it's just a matter of time before research and development of civil applications where UAVs are more numerous, will surpass those of the military

Fig. 1 – The estimated evolution of the European military and civil UAV markets [2]

2. LUAVS IN MODERN DISASTER MANAGEMENT MECHANISMS EMERGENCY SITUATIONS

In situations marked by natural disasters caused by man-made event, it is essential that the response of those who must act in such critical situations to be a quick one. This may help especially the injured and at risk persons.

Using a light UAV, which can be launched from nearby the disaster scene, or from a command center, will allow, firstly, to obtain in a short time an extended picture of the degree of destruction and damage, and will allow warnings on existing and potential hazards.

Also, with the help of the LUAV, it may be created a live map of access and exit points. This allows prioritizing resources in order to start effectively managing the disaster site.

LUAV may be equipped with a high resolution camera, high definition video camera, a high resolution black and white low light camera or a camera, high resolution IR camera. All cameras may provide live feed so that on-ground personnel will see the disaster scene as being on-site. Also, the images obtained, they may be recorded for a thorough examination and review.

Thus, with a LUAV, it may be obtained assistance of quality in providing summaries on the current situation. Decisions on what to do are based on the analysis of what happened, with information obtained with a high probability.

This emergency situation is managed effectively and human and material resources that are allocated to redress the situation may arrive in time to all those who really need them.

3. NON-INTRUSIVE SURVEILLANCE OF THE ENVIRONMENT

Natural ecosystems have a wide distribution not only spatial, but also a wide range time variability, which makes their monitoring difficult. Since ecological systems are functional systems with complex organization, generally, the structural modifications are visible either from one year to another, and only in case of major environmental accidents, or if developing on short term.

Monitoring system which must be created aimed at identifying and quantifying the state variables that characterize the structure and functions of ecosystems. Also the monitoring system should emphasis the internal and external factors that could threaten their ecological integrity of the ecosystems.

The goals set for such a monitoring system are: aerial surveillance of the protected areas, in order to help their conservation and preservation of the biological diversity. As a result it may be controlled - without the direct presence of man - different ecosystems in severe environmental conditions, such as, for example, those existing in nature reserves. [3]

Starting precisely from non-involvement in the environment, it was necessary to design an aerial vehicle that is based on an alternative propulsion system, which should not alter the environmental parameters monitored.

4. MEDIAS - A NON-POLLUTING LUAV, MEANT TO MONITOR THE ENVIRONMENTAL PARAMETERS

As far as the UAV with the above mentioned destination is concerned, there are a number of special design restrictions resulting

from the limited field of activity where it has to be used.

The environmental monitoring project described in this paper mainly focused on interaction with the environment. The authors carefully considered its environmentally-friendly dimension. Consequently, the design specifications required that the vehicle should have the lowest possible impact on the environment. For an UAV meant to monitor the parameters of the natural environment, the main restriction is to be non-polluting, in order not alter the environmental parameters which have to be measured, in any way.

Engine and propulsion. This first design feature is at the same time a design restriction requires solutions which involve particular aerial vehicle propulsion. In short, the design task is to have a non polluting propulsion. Our solution was an electric engine driving a propeller.

Speed and autonomy. Other secondary UAV characteristics connected to the task of performing scientific research missions are:

1. They do not need a high cruise speed; this is due to the fact that the vehicle carrying mobile sensors should also be able to keep the same aerial position for a long time in order to perform certain tasks of monitoring natural environmental parameters;
2. Since it has been assumed that the cruise speed would be low, the duration of the mission / the autonomy should be - on the contrary – higher, amounting to several hours (up to 24 hours or more);
3. Since mission autonomy should be relatively high for a small LUAV (less than 150 kg) – "Light UAV-category", this implies that the propulsion system must to be highly efficient. At the same time, the fuel tank and/or the onboard power source should provide increased autonomy.

Taking into account these characteristics, we searched for solutions to increase the efficiency of the propulsion.

As a first solution, we adopted a ducted propeller due to its superior efficiency.

Afterwards, we vertically redirected the exhausted air currents in order to add some reactive force to the sustentation. The Coanda Effect seemed to be a suitable solution, because it was able to vertically redirect the exhausted jets from the propeller duct, adding more air masses from the vicinity of the vehicle in the same process. All these additional effects were achieved only by reusing the energy of the air entrained by the propeller.

Size/dimensions of the vehicle and payload. As far as the dimensions and weight of the vehicle are concerned, there are more constraints. First, we need a payload of at least 3-5 kg, but we also have to keep the overall size under a minimal value (taking into consideration the deploying demands).

If the mission requires more or heavier sensors and equipment, we shall add an extra inflatable chamber inside the UAV filled with helium, making it a type of a balloon of no more than 1..1.5 m in diameter.

Final design. The MEDIAS project is a VTOL UAV with a hybrid design.

Because of the restrictions imposed on this aerial vehicle, the solution which was finally chosen is characterized by the fact that the UAV shall use the Coandă Effect (I) and an electrically driven propeller (II); alongside these features, optional conversion and use of solar energy will compete at improving and increasing the UAV's mission autonomy. The helium optionally added inflatable chamber (III) will also increase the functionality of the MEDIAS-LUAV.

The specific contribution of each device to the propulsion and sustentation of MEDIAS

aerial vehicle is shown in the next scheme (Fig. 2)

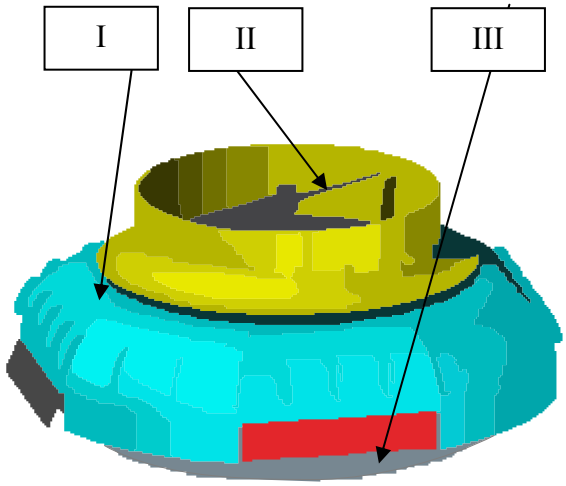

Fig. 2 - The specific contribution of each device to the propulsion & sustentation of MEDIAS-LUAV [4]

The first tasks for the experimental model within the project will be either photo- or video- recordings with scientific purpose or real time monitoring of the nature reserves and of the areas found within the range of the remote control.

Besides the measurement of environmental parameters, the MEDIAS-LUAV described previously will be able to carry out a large variety of missions such as:

- Wildlife inventory and species conservation, especially in mountains or wetlands,
- Forestry or fishery inspection,
- Forest and crop disease management,
- Forest and crop fire detection and firefighting management,
- Monitoring of natural disasters (water flows, avalanches, oil spill tracking) etc...

5. CONCLUSIONS

1. When studying the environment, those LUAVs, that have a suitable structure designed in a such manner as to not pollute by themselves, are an appropriate solution. MEDIAS-year LUAV is an example of non-polluting aerial vehicle, meant to monitor the environmental parameters and, at the same time, having the lowest possible impact on the environment.

2. The vehicle will have an innovative design being a hybrid between the following three devices:

I. An air vehicle - propelled by air jets;

II. An air platform - which ensures its sustentation by using a propeller;

III. An aerostat - which contributes to the improvement of some of the flight parameters.

3. The MEDIAS project has a notable characteristic: it uses the well-known, yet not so much studied, Coandă Effect, in order to sustain, propel and steer the vehicle.

This effect seems to be more promising than those used nowadays, regarding the energetic efficiency supplied.

4. MEDIAS-LUAV project is also an interdisciplinary one, environmental sciences specialists joining their efforts together with engineering sciences ones.

6. ACKNOWLEDGEMENTS

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