

A UAV for search and rescue

TECHNICAL FIELD

[001] This invention relates to unmanned aerial vehicles (UAV), particularly UAV provided with means useful for unmanned search and rescue operations to complement or extend the range of conventional manned search and rescue.

BACKGROUND ART

[002] Accidents and crashes at sea or mountainous region resulting in casualties are usually difficult to locate and rescue due to the wide expanse of the ocean or wilderness whereby the nearest source of assistance is probably hundreds or thousands of miles away. It is always a race against time because, in addition to possible injuries already sustained in the accident, the survivors face dehydration and exposure, leading to exhaustion, hypothermia, drowning or starvation even for a healthy survivor in fair weather.

[003] In such maritime search and rescue, rescuers face a very wide area of the ocean, mountains or jungle to be covered and difficulty in spotting casualties in the wide expanse of water, vegetation, canopy or snow. Normally, such a search and rescue operation would start at the last known location of

the ill-fated vessel or aircraft. Rescuers will start to scan and search likely areas relative to this last known location by air in a systematic manner so as to increase the probability of finding survivors in shortest time.

[004] Human sight fallibility as result of fatigue and other physiological problems may also hamper the search in addition to dangers to the rescuers themselves. If there is a large number of survivor, a helicopter reaching them could only be evacuating 2 or 3 survivors at a time and therefore passive assistance and emergency supplies are provided to the remaining survivors to keep them alive while awaiting for a rescue ship or another helicopter or rescue party to arrive.

[005] Employing UAV in at least the search part of the mission would be advantageous without the dangers and fallibility of manned flight arising from fatigue, visibility and dangers posed by weather elements, so that once the location of the survivors are found and basic sustenance provided to them, a resolute rescue by manned missions may be mounted. Advances in UAV technology presently have seen prototypes such as NASA's Helios solar-powered UAV having the potential of unlimited flight time, while the Boeing Condor UAV with combustion engine currently holds the record time for flight endurance at 58 hours 11 minutes and a top speed of 230 mph.

[006] It is known that the endurance of internal combustion engine UAV depends on the percentage of fuel burned as a fraction of total weight in the

Breguet endurance equation and so is largely independent of aircraft size. Hence, many of the more manoeuvrable and successful UAV models are as large as a fighter jet such as in the case of MQ-1 Predator (for reconnaissance and combat purposes) which may carry 500 kg of payload, and the even larger RQ-4 Global Hawk reconnaissance UAV which may carry up to 6400 kg of hardware. As such the Global Hawk has a lot of room in its payload for high resolution imaging systems such as the Synthetic Aperture Radar (SAR) that can penetrate cloud-cover and sandstorms, together with Electro-Optical/Infrared (EO/IR) imagery. It is possible to launch a Global Hawk from a base 4500 km away and let it survey 100,000 square kilometres of terrain for 24 hours before flying back to base.

The aforesaid UAV do not have the manoeuvrability of a helicopter when it comes to approaching survivors found in the search. A search and rescue UAV would need to approach with care the survivors floating disparately over a wide surface are of the water so that its landing as proximate as possible to them does injure, kill or add to the misery of the survivors.

SUMMARY OF DISCLOSURE

[007] Our invention endeavours to provide a UAV for search and rescue purposes to complement manned search and rescue currently practised wherein the above-mentioned disadvantages of the prior art may be overcome

or ameliorated. In accordance with a first aspect of our invention, a UAV for use in search and rescue operation comprises a visual sensor capable of being remotely monitored, a transmitter capable of broadcasting a signal to be received by at least a search and rescue operator; and a container which is releasable from said UAV in flight, said container containing at least an article for survival, food, water and inflatable article.

[008] In a second aspect of our invention, our UAV is further provided with a floatation means capable of providing buoyancy on water to said UAV and other objects.

[009] The aforesaid container releasable from the UAV is preferably a drop pod having buoyancy sufficient to keep at least a person hanging thereunto afloat. The drop pod may be released from the UAV and dropped by parachute.

[0010] In a third aspect, our UAV is further provided with at least one or combination of heat sensor, electro-optical or infrared (EO/IR) sensor is provided on the UAV.

[0011] In a fourth aspect, water sensing means is provided on the drop pod capable of sensing it having landed on water. Preferably, the sensing of water triggers a light beacon to operate, or a radio wave tag signal to be transmitted indicating its location. The tag signal transmitter may be incorporated as a

transponder capable of receiving GPS downlink signals, determining its location and transmitting its location coordinates to search and rescue operators.

[0012] As an alternative embodiment, the UAV's fuselage itself includes emergency supplies in its payload for the casualties' emergency self help, including at least one of lifejackets, flares, whistles, food, water and the like.

[0013] As a preferred embodiment, the floatation means of the UAV and/or drop pod may be provided by a float, pontoon, detachable pod, buoyancy from sufficient fuselage or displacement, or inflatable bag. Fixtures are provided on the UAV and/or drop pod to enable survivors to hold onto it as it floats on water.

[0014] As another preferred embodiment, the UAV and/or drop pod may be retrieved from its landing site, resupplied and relaunched for continuous operation. Our proposed UAV may form part of an unmanned aircraft system (UAS) for search rescue comprising the UAV, a control centre which may be a mobile control centre, a manned rescue aircraft such as helicopter fitted with a signal transponder for homing into the signals from the UAV and in contact with a ground control for search and rescue.

LIST OF ACCOMPANYING DRAWINGS

[0015] To facilitate better understanding of our invention we shall refer to the following drawings by way of specific or preferred embodiments which are exemplary and not limiting, in which:

[0016] FIGURE 1 shows a perspective view of a proposed UAV according to our invention from the vehicle's ventral side;

[0017] FIGURE 2 discloses schematically a cross-sectional view of a drop pod of a UAV according to our invention;

[0018] FIGURE 3 illustrates a schematic arrangement of the search and rescue operation with the UAV having located the survivor and released a drop pod; and

[0019] FIGURE 4 shows schematically a comparison between rescue of survivors which are land-based and at sea.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] While most of our description of the invention is central upon the UAV, it is obvious that the search and rescue operation is comprised of a unmanned aircraft system (UAS) in which the UAV may be monitored and controlled. Accordingly, the system typically comprises of the following

components, i.e. an autonomous UAV, at least an electro-optical (EO) and/or infra-red (IR) sensor payload, and drop payload containing signalling systems and emergency or survival supplies.

[0021] With collective reference to FIGURE 1 – FIGURE 4, the UAV's **1** flight will be controlled by a ground operator. By "ground" we mean to cover UAV control that may be mobile, e.g. based on a ship or an aircraft. To search for casualties, the operator can view a video feedback from the optical sensor onboard the UAV. When the casualties are found, the operator will initiate a drop of a container or drop pod **4** containing emergency or survival payload near to the casualties. The drop location will immediately be captured to be passed to the search aircrafts. The ground operator will then fly the UAV to continue on its search path to look for other casualties, If there are more expected.

[0022] A propeller engine **2** acts as the main source of thrust power for the UAV. The UAV is also equipped with EO and IR optical sensors **3** that capture and videos and images to be transmitted back to the ground operator. The UAV is also modified with payload pylons capable of holding and dropping the emergency drop pod **4**.

[0023] The emergency drop pod, as shown in FIGURE 2, is designed to be shock-proof and watertight. A parachute **10** will be deployed upon drop to soften its landing on any surface. Manufactured of high impact resin or polyester will

ensure it will not break upon impact. The pod will be waterproofed and designing to be buoyant. The will allow it to float on water bodies, also acting as a flotation device for the casualties to hold on to. When dropped onto water bodies, the pod will stay afloat due to its construction from buoyant materials and/or displacement. With water sensors, impact sensors and accelerometers **11** in the pod, the onboard system **7** will know when and where it has landed on, whether on solid grounds or water bodies. Once landing is confirmed, the onboard system will activate flashing beacon lights **5**, emit smoke signals **6** and/or start transmitting a radio signal **8**. These will allow search helicopters fitted with signal transponders to locate the casualty either with light, smoke, or electronic radio signals. If the pod is carrying weight of supplies and components more than its buoyancy could carry, the water sensor may also be arranged to trigger inflatable bags to be deployed to assist in keeping the drop pod afloat.

[0024] The pod will contain emergency supplies. Lifejackets, flares, lights, whistles, fire-starters, food, water and any other supplies can be stored and accessed through a hatch **9** by the casualties to prolong the survival probability, while waiting for the rescue helicopter.

[0025] During a search and rescue operation, the UAV **13** flown by ground operators will search for the casualties. When the casualties **15** are found with the onboard EO and IR optical sensors **14**, the ground operator will trigger an emergency pod drop. The drop parachute **17** will immediately deploy once the

pod **16** is released from the UAV's payload pylons. As the pod is designed to be shockproof and watertight, it can be used in both land and sea regions. Beacon lights **18**, smoke signals **19** and radio tagging signals **20** will all be emitted when the pod has landed.

[0026] As with the nature of UAV, a control centre is required for monitoring and controlling the UAV as well as software and other elements such as the manned rescue planes, helicopters and/or ships and thus the overall configuration of UAV may be considered as a system. For example, a helicopter may be fitted with a signal transponder for homing into the signals from the UAV and in contact with a ground control for search and rescue. It will be apparent to a skilled person that such systems may be configured using the UAV proposed in the present invention in many variations or modifications. Many of the UAV's components mentioned above may be modified or substituted with alternatives or equivalents. These variations or alternative embodiments are to be considered as falling within the letter and scope of our claims that follows.

CLAIMS

1. A UAV for use in search and rescue operation comprising:
 - a visual sensor capable of being remotely monitored;
 - a transmitter capable of broadcasting a signal to be received by at least a search and rescue operator; and
 - a container which is releasable from said UAV in flight, said container containing at least an article for survival, food, water and inflatable article.
2. A UAV according to Claim 1 provided with floatation means capable of providing buoyancy on water to said UAV and other objects.
3. A UAV according to Claim 1 wherein the container is a drop pod having buoyancy sufficient to keep at least a person hanging thereunto afloat.
4. A UAV according to Claim 1 wherein the drop pod is released from the UAV and dropped by parachute.
5. A UAV according to Claim 1 wherein at least one or combination of heat sensor, electro-optical or infrared (EO/IR) sensor are provided on the UAV.
6. A UAV according to Claim 3 wherein water sensing means is provided on drop pod capable of sensing it having landed on water.

7. A UAV according to Claim 6 wherein the sensing of water triggers a light beacon to operate.
8. A UAV according to Claim 6 wherein the sensing of water triggers a radio wave tag signal to be transmitted indicating its location.
9. A UAV according to Claim 8 wherein a transmitter is incorporated as a transponder capable of receiving GPS downlink signals, determining its location and transmitting its location coordinates to search and rescue operators.
10. A UAV according to Claim 1 wherein the UAV includes emergency supplies in its payload for the casualties' emergency self help, including at least one of lifejackets, flares, whistles, food, water and the like.
11. A UAV according to Claim 2 wherein the floatation means is provided by a float, pontoon, detachable pod, buoyancy from sufficient fuselage or displacement, or inflatable bag.
12. A UAV according to Claim 11 wherein fixtures are provided on the UAV drop pod to enable survivors to hold onto it as it floats on water.
13. A UAV according to Claim 1 which is retrievable from its landing site, resupplied and relaunched for continuous operation.

14. A container, including a drop pod, for mounting onto and release from a UAV according to any one of Claims 1 – 13.

15. An unmanned aircraft system for search rescue including an UAV according to any one of Claims 1 – 13, a UAV control centre which may include a mobile UAV control centre, a helicopter fitted with a receiver for the signal from the UAV's or drop pod's transponder for homing into the signals from the UAV and communication means to be in contact with a ground control for search and rescue.
