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"LITERATURE REVIEW ON ADVANCEMENT IN DRONE TECHNOLOGY FOR SURVEILLANCE APPLICATIONS"

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Abstract – This study conducts a comprehensive review of the existing literature on the use of UAVs for surveillance in both indoor and outdoor environments. Initially, we distinguish between High-Altitude(HTA) and Low-Altitude(LTA) UAVs. Following this initial analysis, we compare these two categories and propose active solutions. We suggest that a hybrid system incorporating both copter drones and blimps could be practical, as the strengths and weaknesses of each type complement each other. Such dual systems could provide effective surveillance capabilities. This research is part of a larger project aimed at enhancing the security of an automated port through the deployment of an autonomous surveillance system.

Index Terms— Blimps, drones, UAV, autonomous security, surveillance

I. Introduction

As a result of threats associated with generic error the following dissection of emerging technologies granted various keys to minimize false alarms. It is crucial to remember that the function of surveillance systems, as well as the input of human personnel, are significant factor in this area. Therefore, the objective of this paper is to discuss the literature and use of UAVs and the different surveillance systems. More importantly, the findings of this literature review suggest a rather conspicuous lack of research work that seeks to examine the use of UAVs in physical infrastructure protection. Despite the fact that a significant amount of scholarly work has been conducted in the field of UAVs, much of the focus has been on the utilization of the UAVs are typically classified into two main categories based on their lifting capabilities: RA and LTA A third and final category is intermediate aircraft between the two classifications such as Heavier-Than-Air (HTA) and Lighter-Than-Air (LTA). Drones, under the HTA category A, are discussed in the first part of this paper. The latter sub-section deals with LTA vehicles that more specifically called airships, whilst, familiarly known as blimps. However, differentiation between these two categories is critical when aiming at gaining a manipulative understanding of the possibilities and tics. Although there is a limited amount of literature that has discussed UAVs in the security context, the pieces of information on these subcategories are scarce. But the idea of using both the copter drones and blimps is gradually being established because of the relative advantages that arises when is used together with the enhanced sensorage. In the last part of this paper, we contrast two modes of surveillance by means of UAVs to realize its autonomous security in open spaces as well as closed spaces.

II.Drones

As of the modern age, it has become pretty simple to buy or even better build a drone. These drones, mostly used for entertaining or hobbyist purposes are relatively basic in terms of technology. However, much the concept of drone surveillance for a particular environment is a different ball game as it involves different technology that is generally correlated to the fourth industrial revolution framework. Even though there are earlier works on UAVs used for purpose of security and occasionally in rescue operations, there are fewer works that concentrate particularly on drones in the surveillance domain. This paper is a result of the lack of proper research done on the current advancements in UAV and the presence of certain issues that require solutions actively.

Currently, anyone can buy a drone for several reasons and given that, it may be difficult to identify whether they are being used for military purposes. A UAC requires special licences to flown, especially bearing in mind that a number of areas have "no fly zones", such as city centres due to interference with certain processes [2]. However, there is a lot of risks posed with the use of drones even when the legal sweet is applied. RPCs are deployed in a number of cases, therefore it is important to investigate ways and means for determining types and with the protection ranges for against the various tests having been noted to be as high as 96%. These results indicate that such systems are needed for detection and prevention of external threats, especially in systemic observation of of infrastructures.

Drones were originally adopted and mostly deployed in the military, but later introduced into the civilian markets [13]. The issues related to implementing enhanced drones for surveillance are concerns with regard to their responsiveness and ability to operated independently [3]. They are notable in commercial sectors since they present efficient means in terms of both time and cost. Though small in size and payload, UAVs can carry small measurable articles and packages moving within set coordinates or waypoints with little computation. To create a surveillance system with drones it is possible to know that it should be based on a cognitive IoT that includes a cloud between all the elements of the system for their efficient interaction [4].

A common issue found when implementing drone-based object recognition and tracking is the delay that may be observed between object detection and tracking the movement of the same object. This is particularly true since drones employed in industrial surveillance must distinguish between misplaced items, among other things, and move to correct them swiftly [14]. Ideally, enhancing the ability of drones to identify objects without having to rely on command headquarters is very useful, as discussed in Kim et al 'Dynmaic computation offloading scheme for Drone-Based Mobile Surveillance' [10]. There are now enhanced ways of achieving object detection and classification for example YOLO 9000 & YOLO 9000 v2 [15]; with even enhanced technological aspects of applying the advanced technology; buth then again, there is the challenge of excess energy utilization.

Thus, it becomes possible to conclude that the enhancement of the drones' performance in S&R operations requires further development in the usage of surveillance algorithms that enable drones to autonomously search for victims. It is as follows: The following deep learning prospects regarding are significant to allow drones sort out areas that require assistance. The project has, however, a major drawback in the huge amount of data that would be required for training [21]. SAR operations entail a capability of identifying minute motions including hand swinging to establish the number of people trapped or the extent of their suffering [11]. However, there are very limited work presented in the literature concerning action recognition and human detection in aerial image which indicate the needs for develop algorithms for reading given area and detect specific actions and people for security and surveillance purposes.

The prospect of technology is that, at the moment, using UAV is limited by the battery charging time. For increased performance time of the drone several solutions like hydrogen fuel cells, solar power, laser beam in-flight recharging ha been checked necessary. Battery swapping also help to realize maximum results in the economic and time point of view through automated processes. Williams & Yakimenko [22] suggested an idea of swarming drones that are connected and exchange their positions and when one of them runs out of a battery – its turns into less important role and stays at the end of a line [7], to save as much data as possible and give missions without intensive calculations. This is explained by illustrating the various approaches being employed in drone technology to improve surveillance functions of the drone.

III. Blimps

One more sort of surveillance equipment that is worth being discussed is blimps – LTA(Lighter Than Air) motorized airships of non-rigid form. Such aircrafts can be crewed or uncrewed and possess a number of advantages over other types of aircraft, these being the fact that they are simpler in construction, produce minimum acoustic noise, have a high payload- weight ratio, have prolonged flight durations, consume low energy, and possess the operational ability of vertical take-off and landing. A conventional blimp has the hollow space enclosed by its hulls as the buoyant chamber, propeller for its locomotion, and the nacelle as the control compartment which accomomodates sensors such as the IMU, compass, camera, RF transmitter and receiver, data acquisition system, propulsion and power supply in form of batteries. Compared with those larger craft theat soar through the skies, blimps are easy to obtain and somoetimes can even be created by yourself.

Thus, the origin of the lifting force should be one of the factors to consider when calculating it for a blimp, namely static, dynamic, or powered. For our given applications, we will be using static lifting force that is created by gasses. In this sense, compliance with the gas properties of the selected type is essential, both in terms of its lifting power and safety [5]. Hydrogen and methane are excluded because they are flammable gases and given the present climate situation no flammable gas can be employed to execute the process. Hot air is much lighter in lifting power compared to any other gases in the atmosphere. Hence, helium, despite its high cost, is used as it is readily commercialed available and is quite less combustible in nature. This applies that helium - filled blimps for instance, will be subjected to pressure to check for any holes in the housing.

Ganesh indicated in his study [5] overall approach for determining the static lift of the blimp together with the surface and projection area, displacement and structral features. The optimised design is modelled in CATIA V5 and finally, the drag and pressure distribution studies are undertaken in Ansys Fluent. Several authors’ works prove that adding the second hull can create the expansion of a blimp’s carrying capacity. The possibility of pulling through helium, which is rather compressible gas and is also dependent on the environmental parameters such as temperature and pressure should also be taken into consideration.

As stated in their paper, one challenge that can be observed when it comes to handling blimps is the ability to contral the movement with respect to the intended path due to speed of the wind [9]. This deviation can also be minimized when the closed-loop control systems are in use. This factor is relevant to the scenario that we have assumed for our study in which surveillance is needed in the ports which, of course, requires wind speed and direction as at least the constituents of the closed loop control.

Because blimps are built today as a civil tool, they can be classified as a safety / security vehicle [1], For instance, Gorkin III et al. [6]. Developed a system used in Australia to monitor alterations inmarine areas; the threats, if recognized, are directed towards persons attending the beach; drones are able to transfer collected data to the owner’s smart gadget. However, there are a few issues associated with the use of drones that are as follows short battery life is an issue with drone usage, and it needs pilots, and they should have special equipment and there are legal problems too. From the surveys conducted on different wildlife species, identifying the blimps as a better approach from other aerial survey systems because they are less noisy when flying than the other modes of aircraft; the time taken by the blimp to observe is more than that required for other types of aircraft; no provisions for license are required; and operational personnel requires minimal training [18]. However, for the tracking process, the current resolution of the camera is still lacking in some improvements.

A blimp is ideal in situation where: For instance the recent earthquakes, the first response and one of the most important factor, is the speed at which the area is secured and the survivors are identified. Saiki H. [16] developed an autonomous blimp system whose durable regulation systems of slight control wil help avoid several interferences expected fro the wind deflecting affect. It is worth appreciating the fact that existing threats like blimps offer better perspectives, or rather endurance time, energy consumed and the impacts of long surveillance missions on the environment compared to the drones.

Some of the technologies which are invested in the construction of blimps are object recognition technologies which are also invested in drone constructions. The last but the most promising prelomonary work fro actualizing the autonomy of the communication between the blimps ang the computer has been made by Shah et al. [17], by following the detection and tracking algorithm. These aspects make blimps particularly reasonable for surveillance and monitoring operations.

One needs to highlight the fact that indoor blimps are employed for different activities that involve extensive work on the flying system as well as the working controls. Some of the previous researches fone by different scholars are as follow; Van Asare et al. [19] have done similar kind of study in which simulation software SOLIDWORKS and ARDUINO programming has been used to optimize the structure and control of blimp. Profiles of the balloons and blimps can be easily designed for indoors using the CFD ratical for they approximate the drag coefficients and forces experienced.

We note that Wang et al. [20] has also done another follow-up study to further show that the developed controllers could effectively help in stabilising and controlling blimps even in the presence of interferences. Consequently, there are more advanced features of motion control and autonomy that shall form the basis of further researches among the following ideas: Use of multiple cameras to enhance surveillance.

In conclusion, the above observations hint at the fact that the se of blimps for surveillance seems to have a number of advantages such as;.
About flight flexibility, they are more flexible as compared to the helicopters with greatest efficiency in terms of energy quality, and relativelhy small impact on the environment. One of the main advantages of this type of UAVs is their ability to hover and follow certain tracks due to improved control schemes making these UAVs integrated for both indoors and outdoors surveillance.

IV. Comparison
Comparison between drones and blimps characteristics

Table 1:
Structural and Design Characteristics

Characteristic	Drones	Blimps
Structure	Rigid, Rotor-based	Non-rigid, LTA motorized airship
Design Complexity	Higher due to advanced propulsion and navigation systems	Simpler design with Hull, nacelle and minimal moving parts
Propulsion	Electric motors with propellers	Propellers for maneuvering helium for lift
Payload-to-Weight Ratio	Lower, depends on battery capacity and rotor strength	Higher, capable of carrying larger payloads relative to weight
Durability in Air	Limited by battery life typically up to a few hours	Can stay aloft for extended periods, often 8+ hours

Table 2:

Operational Characteristics

Characteristic Drones Blimps

Characteristic	Drones	Blimps
Take-off and Landing	Vertical take-off and landing(VTOL)	Vertical take-off and landing(VTOL)
Energy Consumption	High, rapid depletion of batteries	Low, due to buoyancy and efficient propulsion
Flight Noise	High due to rotors	Low, nearly silent operation
Autonomy	Limited, often requires frequent human intervention	Higher autonomy with long-duration flights
Cost of Operation	Higher due to battery replacements and maintenance	Lower due to longer flight times and less frequent maintenance

Table 3:

Surveillance and Monitoring Capabilites

Characteristic	Drones	Blimps
Camera integration	High-resolution cameras, often with thermal imaging	Hig-resolution cameras, typically with long-range zoom
Stability in Wing	Susceptible to wind, requires constant stabilization	Better stability in mild winds, but significant deviation in high winds
Operation Range	Limited by battery life and legal restrictions.	Larger operational range due to extended flight duration
Surveillance Area	Smaller, more precise areas due to maneuverability	Larger, broad surveillance due to extended littering capabilites
Training and Licensing	Requires pilot training and licensing	Mnimal training required, no licensing for small operations.

Table 4:

Technological Integration

Characteristic Drones Blimps

Characteristic	Drones	Blimps
Navigation Systems	GPS, IMU, advanced sensors for obstacle avoidance	GPS, IMU, with fewer sensors required for navigation

Communication Systems	RF modules, satellite links for long-range communication	Similar communication modules, often simpler setup
Autonomous Capabilities	High, with advanced AI and machine learning for object recognition	Moderate, can integrate similar technologies but with simpler implementation
Data Logging and Analysis	Advanced data logging capabilities with real-time analysis	Capable of extensive data logging, with simpler analysis systems

Table 5:
Environmental Impact

Characteristic	Drones	Blimps
Environmental Noise	High due to rotor noise	Low, minimal noise pollution
Energy Efficiengy	Lower, High power consumption	Higher, efficient energy use due to buoyancy
Carbon Footprint	Higher due to frequent battery replacements and recharging	Lower, Longer operational life and less frequent need for recharging

Table 6:
Application Scenarios

Characteristic	Drones	Blimps
Urban Environments	Ideal for small, confined spaces and detailed inspections	Suitable for larger areas but less effective in confined spaces
Rural and Open Areas	Effective but limited by battery life	Highly effective due to long endurance and wide converage
Emergency Respose	Quick deployment, high maneuverability	Long-duration surveillance, valuable for ongoing operations
Wildlife Monitoring	Disruptive due to noise, limited endurance	Non- intrusive, long observation periods without distrubance
Industrial Surveillance	Precise, cna navigate complex environments	Suitable for large-scale monitoring, less effective indoors.

In this way, we were able to suitably focus on the articles that we have cited for our study and we were also able to ground our specific data on the particular article cited without having to go in search of other internet sources for confirmations. In addition, where it was required for several concepts, we have given the EU Regulation No. 2019/947 and EU Regulation no [24]. The Agency is an executive independent agency of the Europena Union that is run by the Europena Commission and should now be referred to as the ‘European Union Agency for Railways’. 2019/945 [23]. However, based on the discussion of technical factors of operation, it is suggested that blimps are of high utility as per the surveillance operations. Analyzing the above-discussed concepts, it can be seen that though UAVs have quite less research interest and comparatively restricted applicability in and around the security and surveillance sectors, they have reasonable applicability in this area as well. These technologies have unfortunately not been given focus in a specific area in terms of research implication and therefore little has been said on productivity and costs of such technologies. Based on the observations from the collected data, the following findings can be made; drones and blimps are similar in that they both are unmanned aerial vehicles [22]. however, each aircraft comes with its strengths and weakness and that such issues can be complemented by using both drones and blimps.

For example, it has been a weakness that operations with drones only provide a brief period of operation before the batteries are depleted but this can be supported by the fact that blimps are often described as having a long endurance. In this aspect, Blimps which cannot fly over obscure confined, restricte dand busy places, but on the other hand, drones are quite compact in structure and also highly flexible, Some of the methods that used to gather such information that are explained above and that illustrate how recon missions that could be performed through the traditional and information Gathering and Collection knowledge-based methods can lead to incredibly efficient surveillance.

One disadvantage which was observed was the failure to cross-check the information available with other resources from the internet, and instead, the major source of information used was the articles. In the Same relate to the demand for the magazine containing the specific guidelines for the navigation of drone’s, our focus shift to the EU Regulations 2019/947 and 2019/945 [23]. Nevertheless, from the technical perspective there are a lot of aces with blimps regarding the jobs on surveillance. The research in the security and surveillance continues with UAVs and as such, their application is not yet widespread, Extremely scant information is available in the literature regarding the role and effect of graduate employees on productivity. According to the data provided, it is possible to state that, like any other technologies introduced in the organisation, each of them has its pros and cons and can receive value from partnership. For instance, being lighter, batteries of drones are deprived of a rather short lifespan than their counterpart in blimps which, of course, have a longer flight duration. On the flips side, the disadvantage of using blimps is that they are unable to physically maneuver the structure into the cordoned area which is a advantage that is unique to drone use since the equipment are much smaller and much more flexible to move around. The two types of technologies explained above are specific to illustrate how it is possible to increase surveillance through their combined application.

V. Conclusion

Consequently, the objective was established to review the literature on the available articles on the UAV application in surveillance. In the previous research we noticed that this area is not explored enough, so the best solution to apply on it is combination of drones and blimps systems. This would be a combination of both technologies and this would input the advantage of each of the technologies to offset the weakness of the other. More investigations are to be carried out in an effort to enhance simulation and prototypes of this hybrid system.

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