Investigation about Use of Drone in a Patrol Purpose and Applicability of this Surveillance Particularly to Existing Legislation

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Abstract— **This article represents an effort to investigate the unmanned aerial vehicle (UAV) or 'drone' as patrolum service, bringing together its diverse forms, current and projected uses and legal challenges it raises, with a view to its large-scale capabilities for searching and identifying people. The relatively tight focus of contemporary recognition systems allows the use of this technology for searching of individuals. Now the degree of surveillance coverage in time and space that the UAV allows is having important effects, drones are increasingly being used in vast array of civilian and governmental situations. Application of drone's usage in public places increases the chance that individuals will come under scrutiny from faraway aircraft without knowing it; there is apprehension in the use of domestic drones due to several safety and privacy concerns. After the introduction, the paper describes the overall features of propagation of drone usage from military to civil purposes; then, in section 3 description of the airship solution is carried out. In the next section, legislative problems are determined for UAVs and the airship basing civilian airspace regulation. Finally, the conclusions of the study are drawn.**

Index Terms— **Unmanned aerial vehicle, surveillance, legislation analysis, privacy concerns**

I. INTRODUCTION

ON May 2010 the Nelson County Sheriff in North Dakota attempted to execute a search warrant on the Brossart family to search for six missing cows in their farm. Three members of the family armed with rifles subsequently chased the Sheriff off the property. The Sheriff then called in back-up an unarmed Predator B drone. The drone observed the Brossart's 12 sq. km farm for four hours at an altitude of 3.2 km. Live video and thermal images of two of the Brossart sons and their mother were relayed to officers parked on a nearby road. From these thermal images officers were able to observe where the suspects were located on the farm and moved in to arrest them when the suspects were observed to be unarmed. The arrest of the Brossart family members became the first arrest of U.S. citizens with the aid of a drone.

This illustrates how drones were used routinely for surveillance. Application of drones usage in public places can be controversial, because of how they have been used – most notoriously as tools for assassination – and because of what may be a public suspicion towards the idea of robotised warfare. The image of drones flying above a city and monitoring the daily movements of its citizens may seem absurdly futuristic but cities have been increasing the amount of law enforcement.

For instance, data systems in New York utilize video cameras, radiation detectors, and license plate readers throughout specific territory.

This highly sophisticated system can alert law enforcement to the presence of unattended packages in buildings and quickly locate a suspect vehicle through access to license plate readers on city streets, bridges, tunnels and law enforcement vehicles. On the face of it, drones can do what video tracking systems can do, and indeed, they carry out the same kinds of missions using the same kinds of equipment, but they penetrate into spaces and territories where other systems cannot or will not go. The essence of the question lies in the uniquely 'unmanned' nature of this technology. In general, contemporary unmanned aerial systems consist of one or more vehicles linked by satellite to a ground station. The inherent capacity for access and persistence that the drone offers is being enhanced by an expansion of drone bases. The relatively low infrastructure requirement of drone operations has enabled a vast proliferation of such applications.

Governmental drone use builds upon these advantages; due to their mobility, the number of scenarios where law enforcement can employ drones is greater than that of other surveillance devices such as integrated video surveillance systems. These smaller aircrafts also have the advantage of access to certain kinds of spaces, this being particularly important in the urban canyon, the dangerous confined spaces of the city environment, where such devices can unobtrusively 'perch and stare', eventually, perhaps, for long periods of time, recharging from the sun. They could also gain access to buildings

It is also used for monitoring natural conservation areas, such as conservative forests and wild life cages from illegal actions like logging, mining and animal hunting.

II. FROM MILITARY TO CIVIL APPLICATIONS

Currently the largest use of unmanned aircrafts is made by

the United States military departments, which have utilized drone technology for various conflicts. It is also used for surveillance along both the Mexican and Canadian borders. The next transition for drone technology will be public use by law enforcement.

UAV's technical qualities permit access in a wide range of scenarios, enabling the delivery of a massively expanded source of data at every level of a military operation. Technically, in it is used for monitoring operation in the borderland as defensive military patrol. Many soldiers now have access to some kind of dedicated aerial reconnaissance even at the level of the smallest patrol, and these small drones grant access for surveillance/reconnaissance to areas previously unavailable for such activities, such as the deep 'urban canyon', and even indoors. We can send a UAV to look down alleys, around buildings, in backyards, or on a roof to see what is up there, dramatically increasing Soldier protection and preserving the force – a vital force multiplier in this era of persistent conflict [2].

The UAV's useful characteristic is its persistence as a surveillance tool, but this persistence is, a little oddly, useful because of the persistent nature of today's conflicts: in the time of endless conflict, the UAV's patience makes it particularly and peculiarly valuable. The data the unmanned air systems generate, however, produce the need for 'unmanned' analysis too. One level of automation seems to entail another.

Several researches have already been done in this field of intelligent UAV. Shafique developed a simple algorithm for detection of elliptical objects in remotely sensed images for UAV applications [3]. However, it is limited for objects that can be segmented as elliptical curves. Other work done by Ibrahim envisage moving objects detection and tracking framework for UAV-based surveillance. Another research done by university of Indonesia shows possibilities to recognize some military vehicles and locate their location by using different algorithms. During the patrol, UAV searches suspicious object from camera view, determines target position. After completing patrol, UAV will generate a map of the area, containing its trajectory and suspicious objects location found by UAV[4].

Drones are capable to carry increasingly powerful lenses that allow significant zooming, and the density of photo sensors is growing at an exponential pace (in line with Moore's law), allowing for higher and higher resolution photos to be taken for the same price camera. However, there are very few proposals seeking to ban the use of high-powered cameras mounted to helicopters or airplanes. Nevertheless, if engineers will continue to increase the lift capacity of drones, and will miniaturize the superior technology already mounted on manned aircraft, drones may eventually possess the capabilities to recognizing people in automatic way.

Automation in recognizing people requires algorithms that are more sophisticated. It needs machine learning approach for visual object detection, which is capable of processing images extremely rapidly and achieving high detection rates. Research [8] for object detection, which minimizes computation time while achieving high detection accuracy. The approach was used to construct a face detection system, which is approximately 15 times faster than any previous approach. It presents a set of detailed experiments on a difficult face detection dataset, which has been widely studied. This dataset includes faces under a very wide range of conditions including: illumination, scale, pose, and camera variation.

Moreover, the term "unmanned aircraft" is also misleading as there are no systems currently available to conduct fully autonomous operations, all systems need an operator as part of the mission. Thus, in almost all instances drones are less capable than manned aerial surveillance platforms, and while the platform is cheaper (but less capable), the personnel costs still remain constant as an officer is required to operate the drone. Granted, there are very sophisticated systems used by the military, but even if law enforcement agencies were able to afford the highly sophisticated multi-million dollar Predator and Reaper systems like those used for surveillance on battlefields. Those systems (both the aircraft and the ground control station) are more expensive than manned helicopters, require a ground crew to launch and recover the aircraft, and require both a pilot and a camera operator [5]. For example, the lack of a pilot does not necessarily imply lower numbers of personnel, as they acknowledge the possibility that UAVs can end up demanding higher commitments of manpower than manned systems, especially if the capacity of the aircraft to endure for long periods in the air is fully exploited: a 24-hour flight cannot be managed by a single crew.

III. PRACTICAL SOLUTION OF LOW COST DRONE SURVEILLANCE

To obviate this need, which involves a considerable financial outflow, the authors proposed to employ a drone airship, whose costs were calculated to be very lower than the traditional UAVs. For the bases of drone was taken Lighter Than Air (LTA) drone airship of modern design [7]. Such vehicle presents different features with respect to the traditional ones, and takes the name of "hybrid", as it presents aeronautical wings and a double-prolate ellipsoid form. The principle of operation is based on the Archimedes' thrust provided by the lifting gas that can be helium or hydrogen. Although hydrogen produces upward thrusts more than 10% compared to helium and costs less, the choice fell on the latter because it is an inert gas.

For the airship realization, different types of materials were chosen. The internal structure is made of composite material, the Artboard / Recore, a phenolic resin foam reinforced with glass fibers. It presents important properties including light weight, high stiffness, ease of bonding and traction, wear, vibration and fire strength. For the sizing of the frame the theory of A. R. Bryant has been considered concerning the internal structure of submarines, for the similarity with the airships. Considering a single ellipsoid, the frame is composed of fourteen coaxial and equidistant rings having an "I" transversal section; the annular profiles are connected via strips and follow the ellipsoid line. Moreover, with the same method, the two ellipsoid

structures are joined through a link involving the four central rings.

The airship motion is assured by three propellers [8], of which one produces the thrust for propulsion and the two other act as thrusters and operate in maneuvering operations. The powertrain scheme [9, 10] is provided in Fig. 1. The internal combustion engine (of the "hot plug" typology) moves an alternator and, by means of the same shaft, the main propeller. The two thrusters, moved by brushless electric motors, take power from the alternator. This powertrain can be classified as hybrid [11], since it involves the employ of both thermal and electrical motors. The main innovation in the propulsion system stands in the employ of a solar panel system, possibly lightweight as allowed by thin film silicon solar cells [12] to exploit the large area exposed to sunlight during a journey. The battery is employed as an energy storage and needs to be properly sized basing on the energy flows that are developed in a journey.
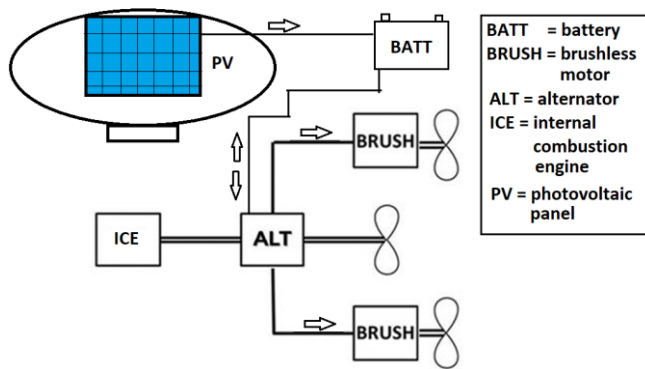

Fig. 2. Propulsion powertrain.

Brushless motors, although mainly restricted to medium-low powers (≤ 50 kW), have numerous advantages: reduced maintenance, great reliability, good performance, easy heat removal, high power/mass and power/size ratios, low acoustic noise and no need of special start devices.

This solution is also ideal for real-time control of traffic network as mean of surveillance

Currently, several countries are active in the industry with companies that produce or operate airships. Some specific features of the airship make it particularly interesting:

1) Great autonomy and durability in flight: the lift force is not generated by aerodynamics but by buoyancy, thus saving fuel.

2) Energy efficiency: in the airship, being the lift assured by gas, engines are used only for motion, this results in energy consumption per hour of flying extremely low.

3) Low environmental impact (emissions, noise, turbulence): low power consumption has the immediate reflection of a lower environmental impact. In fact, the levels of air and noise pollution are almost negligible with respect to a traditional aircraft.

4) Ability to carry out operations in areas without airports: airship can land and take off vertically, therefore it doesn't need long runways. This does not mean that it can operate without an underlying infrastructure, which are instead necessary [13].

IV. DISRUPTIVE INNOVATION PERSPECTIVE FOR DRONE SURVEILLANCE VS PRIVACY LEGISLATION

Due to drone's mobility the number of scenarios where law enforcement will employ drones is greater than that of other surveillance devices such as integrated video surveillance systems or officer body cameras. Although at the moment, civilian airspace regulations severely limit the use of drone technologies and it is likely that the biggest innovations and effects will ultimately occur in the civilian sector. The assistance of drones is an important tool for law enforcement in scenarios where the largest amount of area has to be searched within the smallest amount of time. However, there is apprehension in the use of domestic drones due to several safety and privacy concerns [1].

The aim to integrate drones into airspace surveillance can meet a plethora of unreasonable search challenges to the warrantless use of such sense augmentation devices by law enforcement to collect information. With the ability to capture high-resolution images and video, sustain mass surveillance, and long-term data retention, the drone presents one of the greatest challenges to society's privacy. Government use of UAVs equipped with technology that dramatically improves on human vision or captures something humans cannot see (such thermal or x-ray images) should be scrutinized especially closely by the courts. As the drone is poised to become the newest in a long line of surveillance tools available to law enforcement, an important inquiry is whether such use will require a warrant, specially to obtain information regarding the activities of an individual's home by using of a thermal imaging device and tracking devices.

In situations under attack, terrorist strikes are undermining security as well as social structures. Since drone technology gives law enforcement officers aerial surveillance equipped with thermal imaging, license plate recognition, and GPS technology, the question becomes whether the Fourth Amendment permits warrantless governmental drone use. The first drone-related legislation appeared in 2013 in 8 States, and after in 2014 extra 5 States also passed laws seeking to address the use of drones by law enforcement. These legislative efforts have been aimed at restricting the government's use of drone technology, while largely allowing the government to conduct identical surveillance when not using drone technology. This absurd anachronism is intentional, as privacy advocates have explicitly chosen to capitalize on the public interest and attention associated with the demonization of drone technology as a way to achieve legislative victories [6].

Increased stealth, speed and autonomy and capability of drones currently to hover "just above an enclosed courtyard" at lower altitudes establish the critical question of what exactly is the publicly navigable airspace and how to define such areas. In fact, through zoning laws, state and local governments can clearly define the rights of landowners in the airspace above their land, in so doing they will answer many of the open questions regarding public vantage points. However, an approach establishes rules of privacy rights above owner ground in airspace lefts open the possibility that surveillance at a higher altitude would be acceptable.

V. CONCLUSION

This research study has shown that the drone surveillance of civil areas is potentially achievable, as it has been done in military zones. An airship model which can be used for long time (6-7 hours without recharging) was presented. This time also can be improved by installation of solar panels. A more serious problem that needs to be solved is legislation.

Drones, by virtue of some of their inherent characteristics in terms of size, great difficulty of detecting them, and how they are perceived, allow access to spaces that conventional surveillance systems cannot access. Relatively cheap and simple unmanned aircrafts are already capable of providing situational awareness at a tactical level that simply could not be afforded by manned means. Two technological trends that have implications for cost reduction in terms of manpower are increased autonomy and automation of video recognizing process.

With drones as in so many areas, the technology is moving far more rapidly than our jurisprudence, and it is important that the courts keep the Constitution relevant in the world of high technology in which we are increasingly going to be living. UAVs are potentially extremely powerful surveillance tools, and that power, like all government power, needs to be subject to checks and balances. Like any tool, UAVs have the potential to be used for good or ill.

Imposition of regulations on what law enforcement can do all the time, for example allowing law enforcement to take a thermal image of someone's home only when they get a warrant. We need to impose rules, limits and regulations on UAVs as well in order to preserve the privacy owners have always expected and enjoyed.

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