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COMPARISON OF DRONE RECOGNITION METHODS

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It is expected that the use of Unmanned Aerial Vehicles, colloquially known also as drones, will see an important grow in the coming years as more cheaper and capable drones enter the market, making possible their use for recreational and economic purposes. These article discuses the security challenges coming from widespread UAV use, why it is necessary to implement Drone Recognition Methods, states the available existing methods and compares them based on their efficiency.
Keywords: drone, UAV, radar, recognition methods.

1. Growing UAV Use in Everyday Life

Unmanned Aerial Vehicles (UAVs) are poised to become ubiquitous as the technology advances, making them less expensive and adding more technical capabilities to the commercial models sold to the public. This particular technology is already being adopted throughout the world and put to use for commercial purposes. These uses go from filming audio-visual media, to monitoring crops and infrastructure, etc. One of the civil purposes that have gathered most attention is the use of UAVs for delivering all kind of products, like for example medicine [1]. This all means that UAVs are set to become a part of modern life as common as planes and cars are now.

There are downsides to widespread adoption of UAVs. As the technology gets more advanced and cheap, more people will be able to acquire it. This opens the doors for malicious actors who may use this technology for breaking the law and causing harm to the public and to private property and interests. It is also evident, that as well as there are accidents in related to cars and planes; it is sensible to prepare for unexpected situations regarding the use of UAVs. For all this it is important to create protocols for UAV detection and neutralization.

2. Risks Generated by Widespread UAV Use.

As the economy prepares for the arrival of mass UAV use, there are already companies that are specializing in anti-drone protection. One of these companies is Cerbair from France. Cerbair has identified four main risks associated from UAV usage, these are mid-air collisions, direct attacks, spying and contraband. The places that would be more susceptible to these risks according to this company are Public Places like Government Buildings, Stadiums and Parks or Plazas; Security and Defence like military bases or

police stations that could be attacked, as well as prisons where illegal objects could be introduced by using UAVs. Other places where UAV activity should be monitored are Critical Infrastructure like Telecommunication Towers, or airports where UAV collisions with planes could put the entire crews and passengers in peril. Finally, Private property could also be a target of drone spying or attacks according to Cerbair [2].

With the risks posed by UAVs identified, it is necessary to implement a strategy to protect a vulnerable place from the possibility of malicious UAV activity. A strategy would consist of detecting the UAV in the first step, informing about the UAV presence to a task force as second step and stopping the device as a third step. To stop the UAV different actions could be taken like disrupting the communication between the UAV and the operator, catch the device or destroy it. This article focuses on the different existing options for Unmanned Aerial Vehicle detection, and analyses the upsides and downsides of each technique, so to be able to make a recommendation on which of these methods is the most efficient [3].

3. UAV Recognition Methods

The methods for recognizing Unmanned Aerial Vehicles found during the research of this paper are the following: RADAR recognition, LiDAR recognition, RF recognition methods, Audio recognition, Recognition through WiFi and Recognition aided by Cameras.

3.1 RADAR recognition

RADAR systems are commonly used to for detecting flying object and UAVs are no exception, although they have limitations when working on drones. The limitations come from the fact that UAVs are smaller and move more slowly than other manmade objects and that makes them difficult to differentiate from flying birds. At the same time, commercial UAVs are usually built from plastic, a material that is less reflective. These characteristics generate a smaller cross-section. To compensate for this problem, RADAR systems that focus on drones, would detect the micro-doppler signature generated by the propellers [4]. Some of the systems being proposed also make use of spectral correlation functions to generate data that is then fed to a deep neural network to efficiently detect UAVs from other flying objects [5].

3.2 Radio Frequencies Recognition Method

The majority of commercial UAVs communicate with the ground operator using the 2.4 and 5 Hz band. Drones that record video also send this information through these bands. This can be exploited to detect UAVs that are

being controlled by RF. The distance for RF detection is of around 426.72 metres. The disadvantage is that a UAV can be autonomous thus not requiring RF communication making this method useless [4].

3.3 UAV Recognition Through WiFi

It is also possible for drones to be able to send and receive WiFi signals. These UAVs use WiFi signals to send audio visual information or as a method of control. Proposed methods for capturing the packet flow being transmitted by the drones. The downside is that there are many WiFi signals, so it would be difficult to determine which one comes from a drone [4].

3.4 Camera Aided UAV Recognition.

These methods use a camera to capture images of drones for detection purposes. Usually the images captured are then used to get data that is fed to a machine-learning algorithm to determine if the data captured includes a UAV. The drawbacks of this are that weather conditions as well as poor light negatively affect the precision of this method. Also a fixed camera would not be able to detect drones coming from a different direction [2].

3.5 UAV Audio Signal Detection

UAVs when flying produce a high frequency sound at the 40 Khz frequency band, this can be taken advantage to create systems that using a drone sound data base, can detect the presence of UAVs. The advantage of this method is that it can detect drones in the night and microphone array is not fixed to a particular place unlike a camera. The drawback is that it can be affected by rain, noisy backgrounds and it is expected that future drones will be more silent [4].

3.6 LiDAR Recognition

Light Detection and Ranging (LiDAR) is a method, which uses light for remote sensing. A sensor produces light, which travels through air until it reaches an object and it is reflected back towards the sensor. Once this happens, the sensor determines the distance to the object. This system could be used for detecting drones, but the amount of data it generates and the costs for using it for drone detection are two of the obstacles for its use in this field [6].

4. Conclusion

Each of the methods analysed have pros and cons. Ideally at least two methods would be combined, so as to efficiently detect drones by covering a method's weakness with another one. A good example would be a RF detection being used alongside audio detection, or a method that uses microphones and cameras to analyse sound and image. Another thing to consider is the necessity of implementing this method on a fixed surface or providing other UAVS with

the capabilities to detect other drones. This would have to take in account that some methods can't be mounted in UAVs. A RADAR system may be able to efficiently be mounted in a drone, but a microphone for audio detection would catch the noise coming from the drone it is mounted making it useless. It is safe to say that for best results, it is recommended to use at least two recognition methods at the same time, but also it must be taken into account that the selection of them depends on the place being monitored and if the system will be implemented in a moving or a fixed object.

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