*i*Journals: International Journal of Software & Hardware Research in Engineering
ISSN-2347-4890
Volume 7 Issue2 February 2019

Drone Detection

Author: Ralph M. DeFrangesco

defr3568@cecil.edu

Abstract

There has been an increase in drones in the skies. This is mostly due to a decrease in cost and an increase in availability. There has also been an increase in drones flying into no fly-zones and onto restricted property. Detection of drones in these restricted areas is difficult, costly, and often ineffective. This paper proposes a method for detecting drones using off-the-shelf hardware and software.

Introduction

Because of their size, low radar profile, and low noise, drones are hard to detect. In their paper, Nguyen, Ravindranatha, Nguyen, Han, and Vu (2016),state that there is a lack of a cost-effectiveand automated way to detect drones.

However, there is an increasing need to detect drones especially when they are flown into restricted or unwanted airspace such as government installations or airports (Clark, Meffert, Baggili, and Breiringer, 2017).

According to Huerta (2013), drones, also known as Unmanned Arial Vehicles, are defined as "remotely piloted vehicles" and "radio controlled vehicles".

Today, drones come with some very sophisticated equipment. You can purchase GPS systems, high resolution cameras and a myriad of sensors (Tingle and Tyree, 2017)

In a paper by Phuan (2016), the author presents a solution that finds the direction of the control signal, and then disrupts the link to the drone. These types of solutions are costly and greatly depend on the geographic layout, and the amount of RF noise in the vicinity.

Current problem

There have been many solutions proposed to address the problem of drone detection. Drozdowicz, Wielgo, Samczynski, Kulpa, Krzonkalla, Mordzonkalla, Mordzonek, Bryl, and Jakielaszek (2016), have developed a detection system based on radar that can be expanded for the tracking, recognition, and imaging of drones.

Nguyen et al, (2016), propose using radio frequency wireless signals to detect drones. They propose two solutions; one using active tracking that sends a radio signal and then listens for a returned signal and a second approach uses passive listening where it receives, extracts, and then analyzes a wireless signal.

Proposed Solution

The materials used to test this proposal are standard off-the-shelf hardware and software. The parabolic dish antenna was purchased off Amazon for under thirty-dollars. The software used to record the sound was Audacity and can be downloaded for free. However, any recording software can be used in lieu of Audacity.

A six-inch parabolic dish microphone, similar to the one in Graphic 1,

Graphic 1

was used as a primary collector. The antenna was placed facing upwards, towards the sky. When the test drone flew over the antenna, you could see the waveform increasing in intensity, reaching a peak, and then tailing off (see figures 1-3). This indicates that a

ISSN-2347-4890
Volume 7 Issue2 February 2019

drone was approaching, flying near the collector, then continuing on.

The drone used for testing was a Parrot Mambo. Any drone could have been used for testing. This drone was used as a matter of convenience. The Mambo is shown in Graphic 2.

Graphic 2

The test

The detector was mounted to pole thirty-inches above the ground. This height was chosen for convenience. Any height could have been used. For the first test, the Parrot Mambo was flown over the detector at a height of two-feet. The signature of the drone flying towards the detector, over the detector, then away from the detector can easily be seen (see figure 1). As we can see in figure 1, as the drone flies over the detector, the decibel level increases. A decibel is defined as a gain or loss in power. Decibels are typically used to describe values in microwave, satellite, and audio systems (Beasley, 2002).

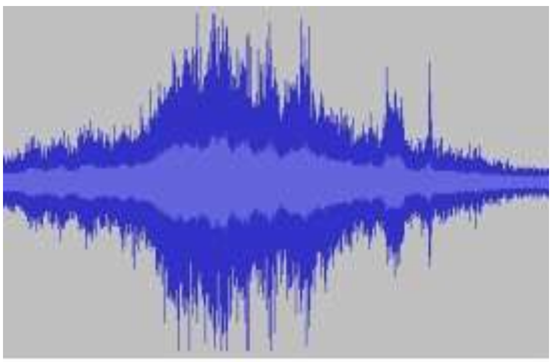

Figure 1 (2 feet above detector)

In the second test, the Parrot Mambo was flown towards the detector at a height of six-feet. The drone signature can been seen flying towards the detector, over the detector, and away from the detector (see Figure 2).

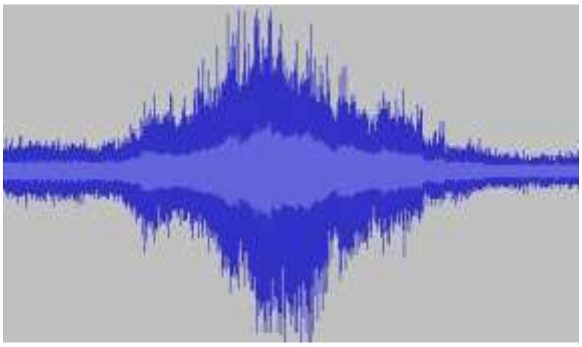

Figure 2 (6 feet above detector)

In the third test, the drone was flown twenty-feet over the detector (see Figure 3). The drone signature can be seen flying towards the detector, over the detector, and then away from the detector.

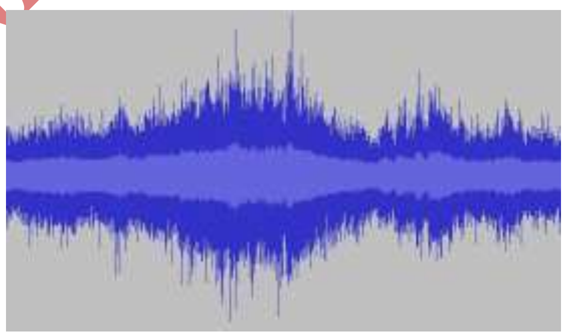

Figure 3 (20 feet above detector)

For greater coverage many larger parabolic dish microphone should be used. These could be mounted on fences, buildings, and signs for the maximum coverage.

Because a drone uses a specific and identifiable acoustic signal, the system will not confuse a drone with a bird, balloon, or stray signal.

Conclusion

Drones are hard to detect. However, the need is growing to detect these devices. Detection is possible using commercial off-the-shelf hardware and software. This paper proposed a simple solution that is cost effective and easy to implement.

Future work

Only one type drone was used to test this theory with. Since different drones have different sound signatures, multiple drones should be used to test with.

Three different heights were used to test with. Additionally, the drone was flown directly over the detector. Different heights should be tested along with flying in an "offset" to the detector, rather than directly over it.

Finally, multiple detectors at different heights should be used for testing. This will allow for maximum detection of a drone.

References

Audacity Software. Retrieved from https://audacity.en.softonic.com/?ex=BB-39.1#app-softonic-review on 12/12/2017

Beasley, J. The dB in Communications. 2002.

Clark, D., Meffert, C., Baggili, I., and Breiringer, F. (2017). DROP your drone: Forensic analysis of the DJI Phantom III. Digital Investigation 22 (2017) S3-S14.

Drozdowicz, J., Wielgo, M., Samczynski, P., Kulpa, K., Krzonkalla, J., Mordzonek, M., Bryl, M., and Jakielaszek, Z. (2016) 35 GHz FMCW drone detection system. IEEE Xplore, June, 23, 2016.

Huerta, M. (2013).Integration of civil unmanned aircraft systems (UAS) in the national airspace system (NAS) roadmap. U.S. Department of transportation Federal Aviation Administration. First Edition, 2013.

Nguyen, P., Ravindranatha, M., Nguyen, A., Han R., and Vu, T. (2016) Investigating cost-effective RFBased detection of drones. ACM June, 26 2016.

Phuan, Y. (2016) Drone alert! Rohde & Schwarz News Magazine.

Tingle, A., and Tyree, D. (2017). The rise of the commercial threat. JFQ85, 2nd Quarter 2017.