

Department of Electrical Engineering RF Based Anti-Drone System

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Abstract

The anti-drone system blocks drones from entering a protected area. This aim of this project is to design a drone detection mechanism using the RF control signal exchanged between the drone and its remote controller. The system generates a high-power jamming signal transmitted over the same carrier frequency and band of the detected drone (project supports only 2.4 GHz band) and directed towards the drone location in order to disconnect it from its controller causing safe landing or return to home mechanisms to triggered.

Introduction

The increase in the number of drones along with their widespread commercial availability raises concerns about their malicious utilization. This motivates our project aiming at minimize unauthorized access of drones to restricted areas.

The objectives of the project can be briefed in the following points:

- Design and prototype a drone detection system.
- Design and prototype a drone prevention system.
- Integrate both subsystems into one automated system, test the prototyped system and Document the whole process.

Drone Detection

Frequency components at 30, 60 and 90 Hz appear only if a drone is communicating with its controller. In case of WiFi, the other user of the same 2.4 GHz band, the component is around 10 Hz, due to its longer period between beacons. The detection system uses mechanical direction finding through a rotating directive antenna.

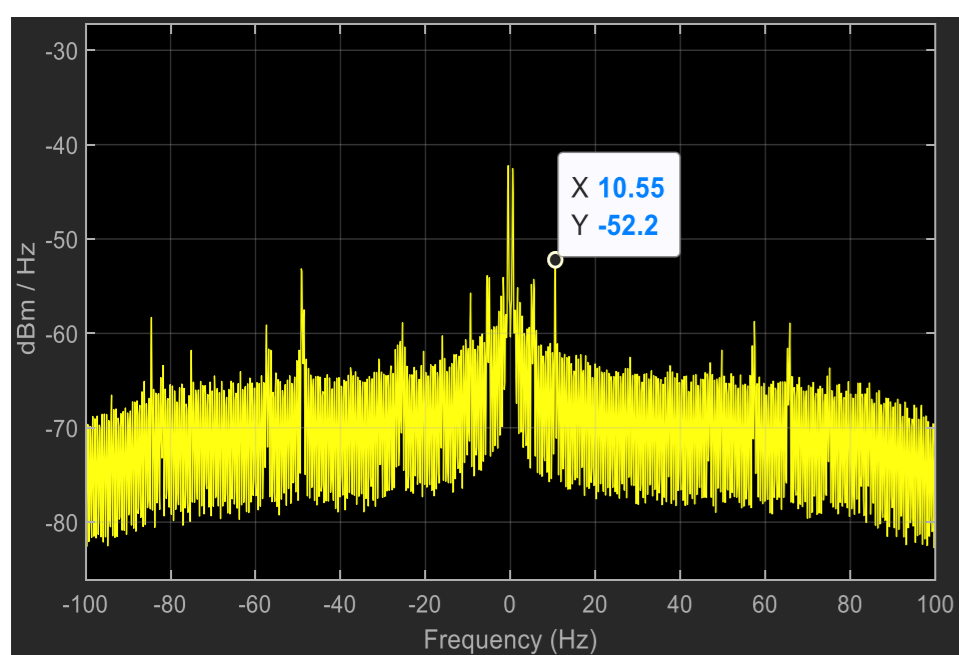


Figure 2: Only Wi-Fi signal

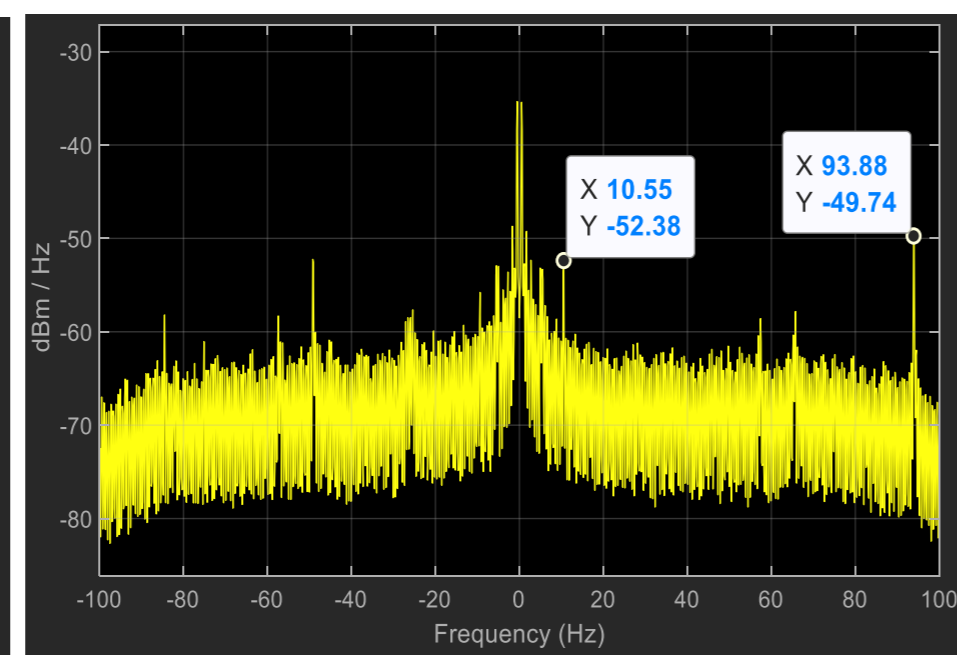


Figure 3: Wi-Fi signal and drone switched on

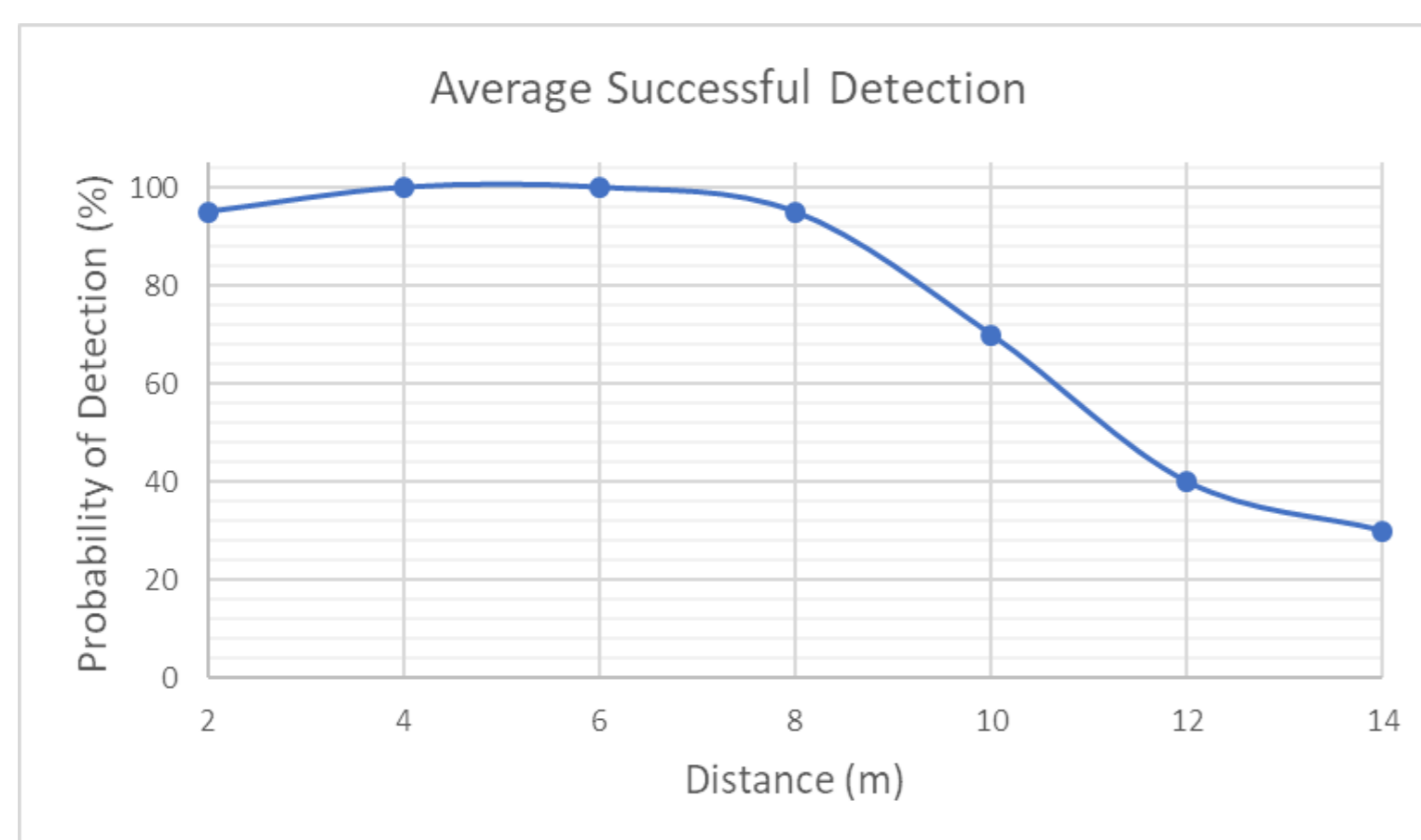


Figure 4: Wi-Fi signal and drone switched on

System High-level Design

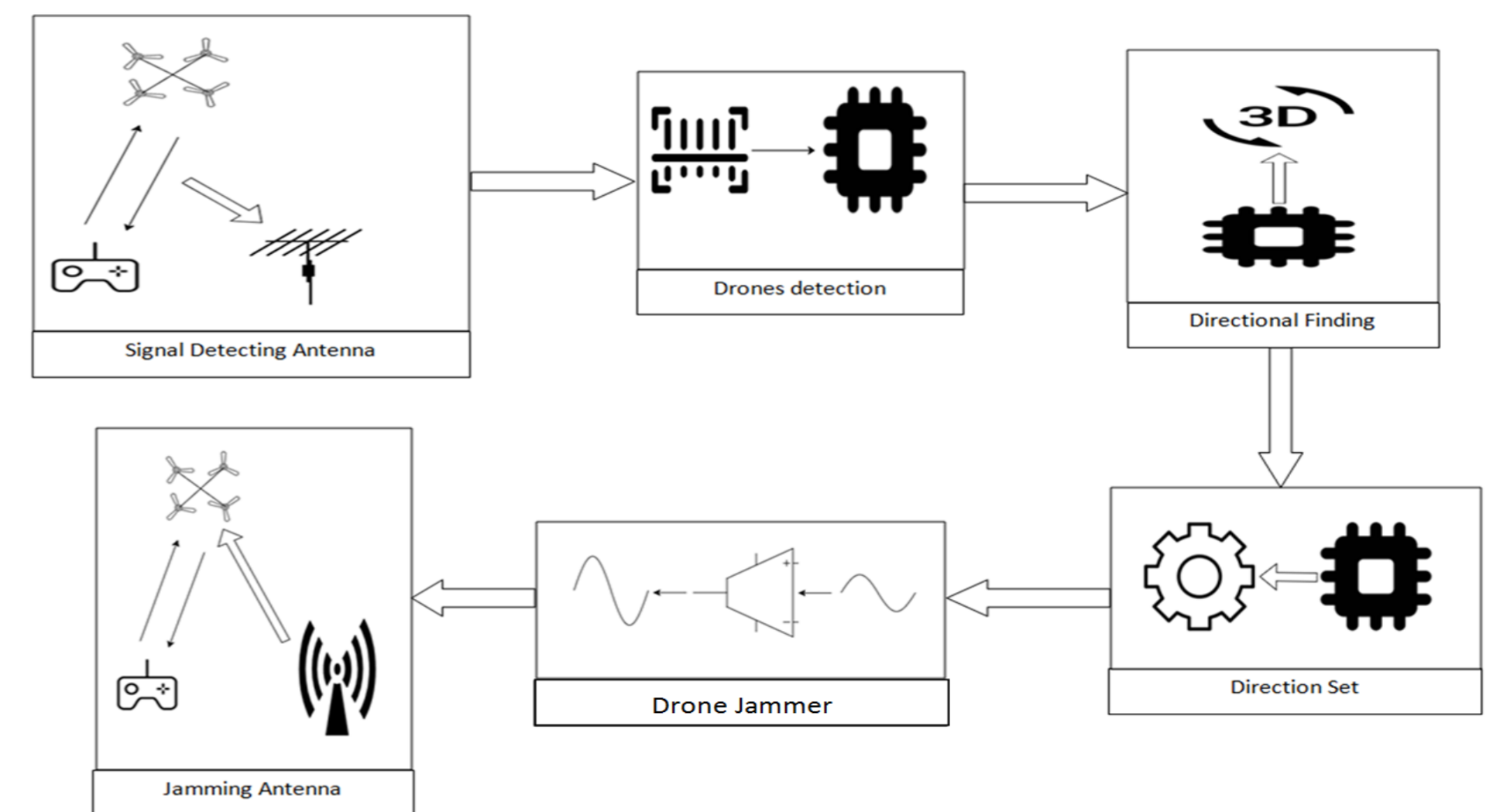


Figure 1 System high-level architecture block diagram for drone detection & jamming system

Drone Jamming

The jamming signal generator generates a noise-like signal with relatively high power either using power amplifier of a dedicated jammer with directive antenna.



Figure 5: Jammer



Figure 6: RF Amplifier



Figure 7: Drone before generating jamming signal



Figure 8: Drone after generating jamming signal, disconnected and lights are off

Integration and Packaging

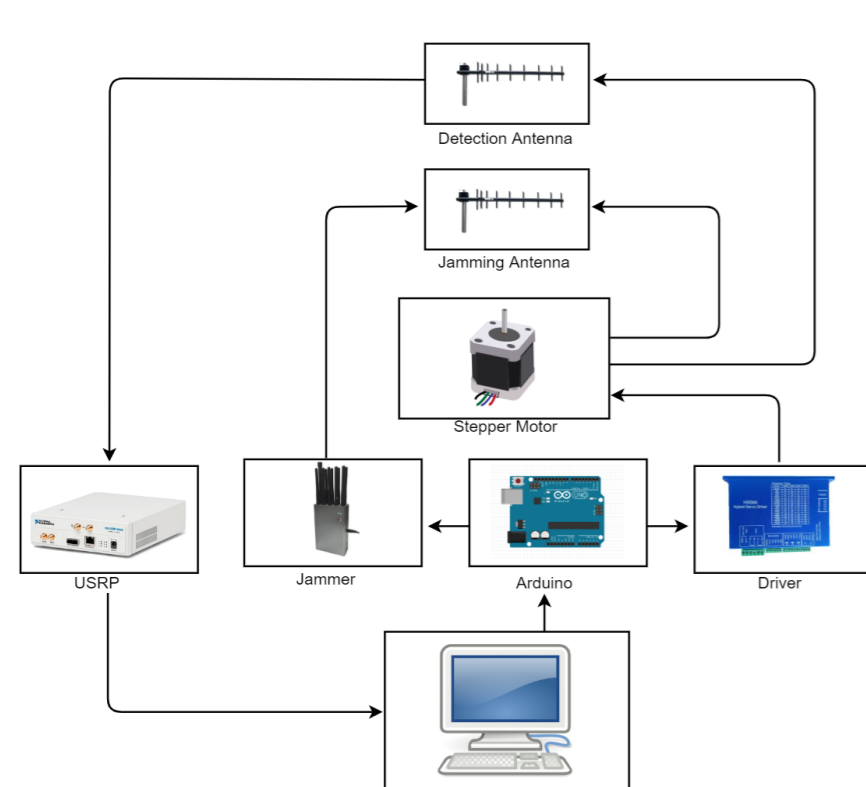


Figure 9: Hardware integration setup

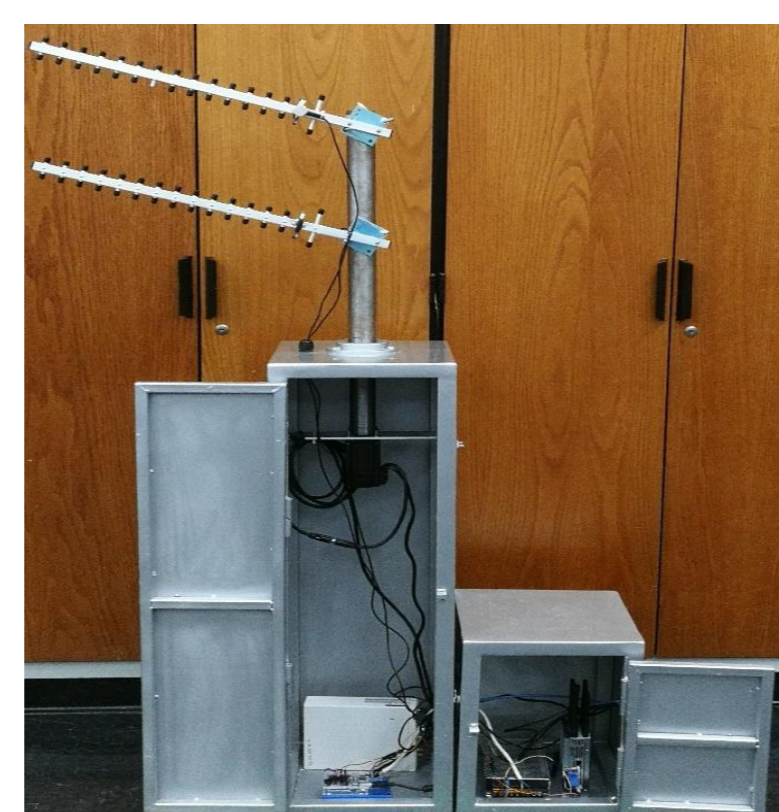


Figure 10: Integrated system showing antenna rotation mechanism

Detection using SDR

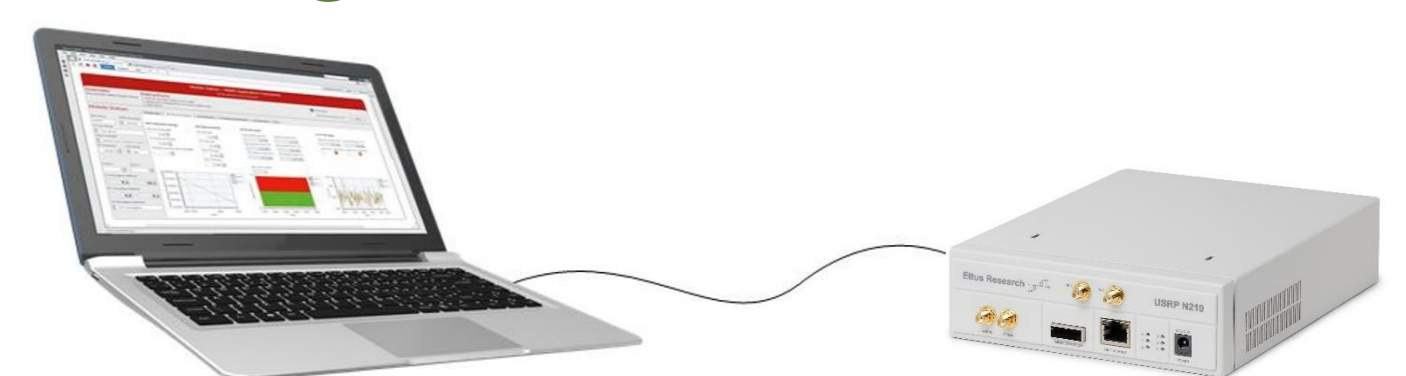


Figure 11: USRP sharing the received samples with the laptop

Conclusion

An anti-drone RF based system is designed, prototyped and field tested to ensure its full operational status. The system was able to detect and jam commercial drones.