Cost-Effective Drone Detection for Rural Emergency Service Agencies

Haywood County Emergency Services

PROBLEM STATEMENT

Haywood County Emergency Services is experiencing an issue where drones (UAVs) are being flown in a potentially unsafe manner at public gatherings. They need an open-source, affordable, readily deployable solution to detect UAV and their operators in an open area. In Haywood County's testing as many as 60% of the UAV they interact with can be detected using remoteID.

REQUIREMENTS

The solution is aimed at rural emergency service departments which may be understaffed, with a tight budget. A minimally viable solution should serve as a low-cost affective framework which can be used by a single volunteer. It should integrate with existing systems being used by Haywood County ES, like ArcGIS and the communications van.

#	Description
1	Determine location of UAV and operator
2	ArcGIS Integration
3	1-2 Mile Detection Range
4	Easy to setup and use by a single operator
5	$1,500 Development Budget

CONCEPTS

- RADAR based drone detection.
  - FMCW
  - Pulse Doppler
  - mmWave (ADAS Automotive RADAR)
- Audio/Visual with ML integration.
- RemoteID (RID) based detection.
  - Both WLAN and Bluetooth transponders must transmit:
    - UAV Identification
    - UAV type
    - UAV location
    - Last known operator location
    - UAV Speed
    - Direction

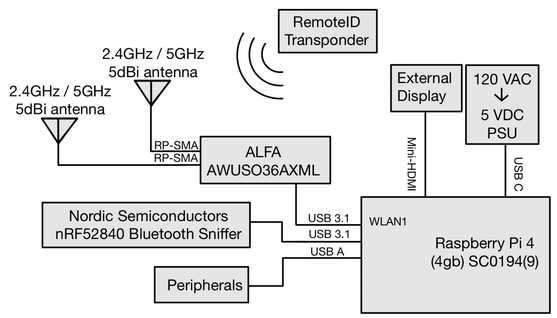
FINAL DESIGN, APPROACH, PLAN

- **Raspberry Pi 4:** Served as the foundation of the project, facilitated user interaction, and ran all necessary software.
- **Airmon-ng:** Worked WLAN interfaces into monitor mode, a critical step in monitoring traffic outside of the current network
- **Tshark:** FOSS terminal-based packet capture and dissection software
- **Zshell:** Used to automated software processes
- **Python Script:** Extracts RID data from packet dissections, then pass them into a CSV file
- **ArcGIS Layer:** Cloud-based mapping service serves as a GUI to display UA and data.

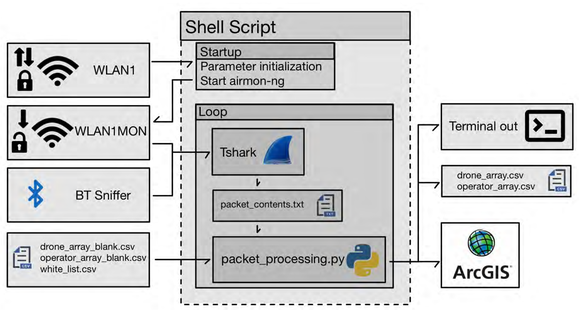
Prototype Assembly

Photo Caption: Prototype assembled, with DJI Mavic 2 Pro used for testing.

Hardware Diagram



Software Diagram



RESULTS

The team produced a detection device which could detect WLAN and Bluetooth based RID transponders. Testing was conducted using a DJI Mavic 2 Pro, DJI Matric 30T, and Ruko R111 BLE module.

Testing Environment

Photo Caption: DJI Matric 30T Landing after conducting distant detection test.

GIS printout

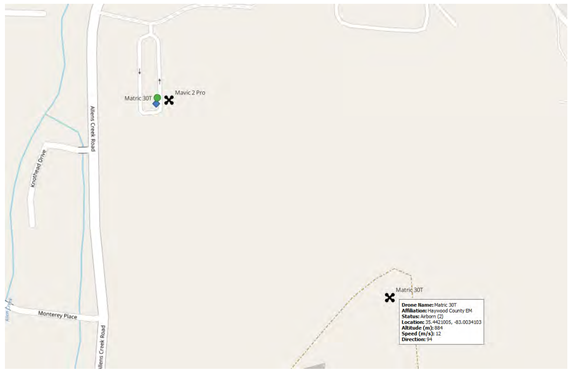


Photo Caption: GIS printout using data from distant detection test.

Terminal Printout

Photo Caption: Terminal printout during distance detection test, screenshot was taken as M30T was coming in for landing, and Mavic 2 Pro was grounded transmitting RID

SUMMARY AND CONCLUSIONS

Both WLAN and Bluetooth based RID were detected using the device assembled. It was tested at Allen's Creek Park using the M30T and Mavic 2 Pro, where it was accurately tracked through the terminal printout. A GIS based graphical printout of the drones' locations was added later.

FUTURE WORK

Integrating a RADAR based solution to work in tandem with the remoteID based solution. This could be a stand-alone system like the Robin Radar Iris, or a system designed with a development kit.

TEAM & ACKNOWLEDGEMENTS

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[2] D. Aouladhadj et al., "Drone detection and tracking using RF Identification Signals," MDPI, https://www.mdpi.com/1424-8220/23/17/7650#B56-sensors-23-07650

[3] ASTM International, ASTM F3411-22a: Standard Specification for Remote ID and Tracking, West Conshohocken, PA, USA, Jun. 17, 2022.