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ANTI-DRONE SYSTEM

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ABSTRACT:

Drone technology has advanced greatly in recent years. Drones have been widely used in a variety of application scenarios due to their low cost and ease of usage, which could pose serious risks to both personal privacy and public safety. The methods they can be employed for terrorist operations are essentially endless because they can fly independently like separate aero planes. A reasonable level of security must be provided by anyone in control of a location that is essential for the efficient operation of a state. Drone defense systems are required since they can be used to assault fortified sites. It is vital to deploy anti-drone systems in sensitive locations for detecting, localizing, and defending against the invading drones in order to reduce these risks. The drone detection system includes radar system and EO/IR system. Radar specifications and features are perfectly suited for the detection of low altitude, slow flying, and small signature targets. The EO/IR system is a long-range, high-performance camera. In this paper we review an anti-drone system and discuss all the features it provides. Furthermore, we discuss the additional features and challenges.

Keywords— Unmanned Aerial Vehicles, Radar, RF Jamming, Neutralization, EO/IR Tracking, Localizing.

INTRODUCTION:

A drone is a type of unmanned aerial vehicle (UAV), which is an aircraft without a human pilot, crew, or passengers. Control technologies' use increased to several non-military applications as they became more affordable and effective. They include monitoring forest fires, precision agriculture, and aerial photography. Anyway, drone possess a great threat to people in regards of privacy and regarding public security [1]. High-end drones cannot be made available to the public. People can misuse the drone; they might fly over the walls and invade citizens privacy. They are usually must be used where the forces cannot be deployed. For example, a place which is higher in altitude.

Anti-drone system is used mostly in security-sensitive areas in defense. Most anti-drone systems used today use military grade components to certify the destruction of dangerous drones. It is a sophisticated security system for protection of sites against unwelcomed drones, preventing them from entering, flying above, or landing inside a given perimeter [1]. This would also mean that the anti-drone system cannot be used everywhere. Deploying an anti-drone technology in a geofencing-free but security-sensitive location is therefore crucial. Drone detection and localization may be possible using a variety of technologies, including radar surveillance, audio surveillance, video surveillance, and radio frequency (RF) monitoring. This system detects the drone and provides the Azimuth and Elevation data of the drone.

FLOW OF OPERATION:

The following block diagram shows internal modules of Anti-drone System. It has following components for the operation.

- Radar System
  RF Sensor Unit
  SIGINT
- EO/IR Tracker
- HI Power Jammer
- Command and Control

Fig 1: Flow of operation.

YSTEM COMPONENTS

Air surveillance Radar

The anti-drone system is equipped with a lightweight air defense portable radar system. It is an X-Band 3D Pulse Doppler radar, characterized by an azimuth mechanical scan (rotating), and elevation electrical scan (linear phased-array). It provides range, azimuth, elevation, and velocity measurements for up to 200 targets simultaneously [3]. The radar utilizes an advanced, state-of-the-art waveform with modern signal processing techniques for high resolution and high probability of target detection, coupled with low radiated power. Detection Range of small UAV (Phantom II) is 3.5Km. Average Transmission Power 150 W.

Fig 2: Radar System.

The radar's cutting-edge technology and the use of X-Band frequency provide an optimal solution for efficient detection of miniature UAVs characterized by small signature, low speed at very low altitude. With 3D tracking, low MDV (Minimum Detectable Velocity) and accurate elevation measurement, it is a perfect, cost-effective solution for threat.

RF sensor

The anti-drone system is equipped with a RF Sensing is a subcomponent aimed to detect drone presence and indicate the direction of which the drone appears by analyzing, signaling channel and radio transmission (both the uplink and downlink) using SIGINT/COMMINT. Another key advantage of the RF sensing components is the fact that it also continuously scans and match the RF signals providing accurate detection with false alarms [2]. Frequency bands RF SENSOR 2.4, Wi-Fi links, RF SENSOR 5.8, Wi-Fi links. Antennas used Omni High Gain Antennas, Dimensions 24 cm, Weight 140 gram, Gain 9 dB. Operational Power [90 – 260] VAC / 24VDC Internal Power Supply.

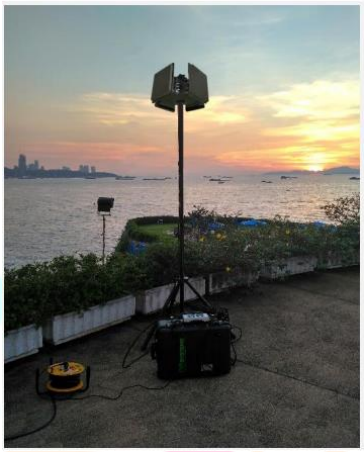

Fig 3: RF Sensor Unit.

Command & Control

Dedicated, configurable, user friendly command & control software, installed on PC.

Jamming System

It is equipped with a high-power outdoor state of the art Jamming system. The systems consist of several jamming antennas, mounted on the EO system's gimbal, aligned with the EO sensors' line of sight.

Standard configuration includes 3-5 antennas: 2-4 antennas for jamming the frequency range of the RC and video links, and a GPS jammer. Selection of the frequency ranges will be done after careful analysis of the worldwide drone threat. As soon as the jammer's transmission overpowers the RC link, the GPS signal, or both – the drone will be grounded at its location or forced away. Drone reaction depends on the software design of the drone but approach the protected perimeter.

EO/IR System

The anti-drone system is equipped with a highly sophisticated electro-mechanically modular electro-optical system, which enables day and night observation for detection, recognition and Identification of targets. The electro-optical sensors are a thermal imaging camera and a daytime TV camera bore-sighted to each other.

Fig 4: EO/IR Tracking System.

WORKING

Aerial targets flying into the protected aerial space are detected and tracked by the radar/RF Sensor/SIGINT. Once a drone has been detected it automatically triggers an Alarm and Alerts the guard of a drone presence. Target/s appear on the command & control screen, showing the exact drone Location, Azimuth, elevation, velocity as it been captured by the RADAR and The RF Sensor. While using the SIGINT capabilities all the necessary Information is extracted about the drone, such as S/N, type, model, true location, operator Location and homing position. Either completely automatic or manually the electro-optical head which is cued to the target sent to the same azimuth/elevation and zoom in to the target presenting the operator with the drone image [3]. The operator uses a variety of software tools, such as optical tracking, contrast reversal and more, in order to make decision whether the target is a relevant drone threat. Upon decision, the operator activates the jamming system. A highly effective set of RF electronic countermeasures are activated in the direction of the intruding drone. The Drone loses its control signal and/or its GPS /GLONASS/Galileo, Bidou signal and is either grounded at its current location, or forced away from the protected perimeter.

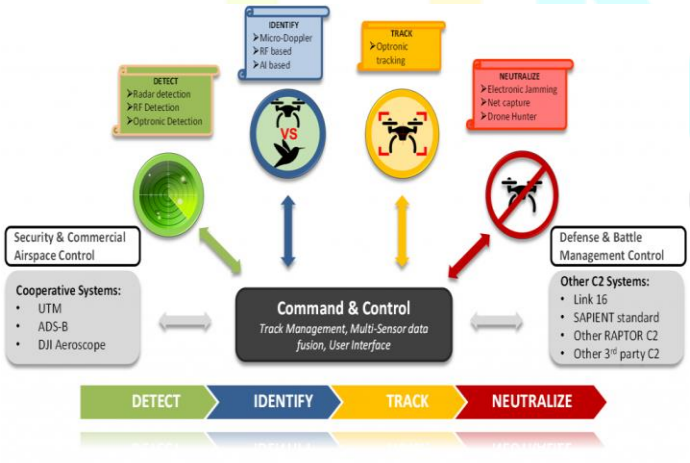

Fig 5: Steps involved in detection and jamming.

Fig 6: Tracking and Jamming System.

OPTIONAL FEATURES

The anti-drone system is a modular system that can be customized to different operational needs, and to different operational, technical, and budget constraints.

▪ Drone Interception – Take over capabilities When the end user's operational requirements require the capability to aggressively disrupt the drone's flight by either physically affecting it, or by taking over its command, several methods can be offered to meet this requirement, subject to obtaining the necessary expert approvals.

▪ Drone Mitigation- The system can be offered with additional layer to destroy the drone, whether as a last resort or upon decision the operator can activate a destruction layer. by activating the remote-controlled weapon station and pressing on the fire button the automatic machine gun releases a deadly blow of 12.7mm rounds on the target and destroy it completely.

EXPECTED SOFTWARE RESULTS

The drone detected can be seen in the Software and the operator can act accordingly.

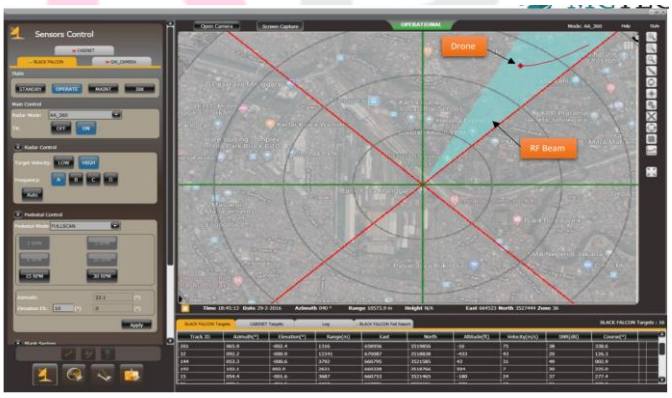

Fig 7: Detection CC Screen.

Fig 8: EO/Jamming CC Screen.

CONCLUSION

In this paper we discussed about the design of a long-range Anti-drone system with jamming capabilities and its optional features. The estimated range is between 15-3.5km detection range for Drone and UAV/UAS RF/SIGINT Detection unit range 3KM, Over 10-2 km recognition range for miniature drones and quadcopters, Over 3-5km effective disruption range.

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