

ADX-2000 Advanced Radar Simulation System / ADX-2000

Project Overview) (

English

The **ADX-2000** is a prototype Command & Control (C2) station designed to simulate modern air defense radar systems. Unlike traditional visual trackers, this system employs advanced engineering algorithms to transform standard optical sensor data into a military-grade Polar Position Indicator (PPI) interface. It features real-time target tracking, trajectory prediction, and automated threat assessment.

ADX-2000 (C2)
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(PPI) .

Technical Specifications) (

1. Sensor Fusion & Processing) (

- **Input Source:** Optical Sensor (Webcam) simulating RF data.
- **Computer Vision:** Motion Detection using Mixture of Gaussians (MOG2) for background subtraction.
- **Coordinate Transformation:** Real-time conversion from Cartesian Camera Coordinates (x, y) to Radar Polar Coordinates (θ, r) .

2. Tracking Algorithm) (

- **Kalman Filtering:** Implemented purely in Python/OpenCV.
 - State Vector: $[x, y, v_x, v_y]$
 - Uses a linear dynamic model to predict target position during signal loss (occlusion).
 - Reduces sensor noise and smooths trajectory data.

3. Threat Intelligence) (

- **Geofencing:** Defined Restricted Airspace (No-Fly Zone) using Polygon Point Testing.

- **Automated Alarm:** Instant system-wide alert upon restricted zone violation.
 - **Threat Matrix:** Dynamic classification of targets based on velocity and geolocation.
 - **Black Box Logging:** Automatic CSV recording of all mission telemetry (Time, ID, Azimuth, Range, Velocity, Threat Level).
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How to Run (

Prerequisites ()

- Python 3.8+
- OpenCV (`pip install opencv-python`)
- NumPy (`pip install numpy`)

Execution ()

Run the main system file:

```
python military_radar_sim.py
```

System Architecture ()

Component	Function	Description ()
PPI Scope	Visualization	.
Kalman Filter	Prediction	.
Data Center	Telemetry	.
Geofence	Security	.

Developer Notes ()

This system is designed as an educational and engineering prototype to demonstrate the principles of **Radar Signal Processing** and **Kinematic Tracking** using accessible hardware.

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