Drone Neutralization Impact Prediction System

A Real-Time Risk Assessment & Decision-Support Tool for C-UAS Operators

Why this matters?

Current Counter-UAS (C-UAS) systems can:

- RF takeover → force landing
- GPS spoofing → redirect
- Launch nets / kinetic interceptors
- High-power microwave disruption
- Drone-on-drone entanglement

These systems identify & neutralize threats — they DO NOT help operators understand what happens after a drone is neutralized.


"If you neutralize the drone right now, where will it fall?"
"How fast will it hit the ground?"
"What is the injury radius?"
"Is this a safe or unsafe moment to intercept?"
"Should you wait for the drone to move to a safer zone?"
DECISION POINT
A real operator has a split second to decide:
"Do I neutralize NOW or wait for it to move farther from the crowd?"

MVP

A working prediction algorithm + simple simulation that outputs:

Predicted fall path if neutralized now
(e.g., “impact ~25m east”)

Predicted risk level
(low / medium / high)

Engagement recommendation:
“Wait 2 seconds — risk reduced by 60%.”

MVP: “Neutralize Now” Scenario Generator

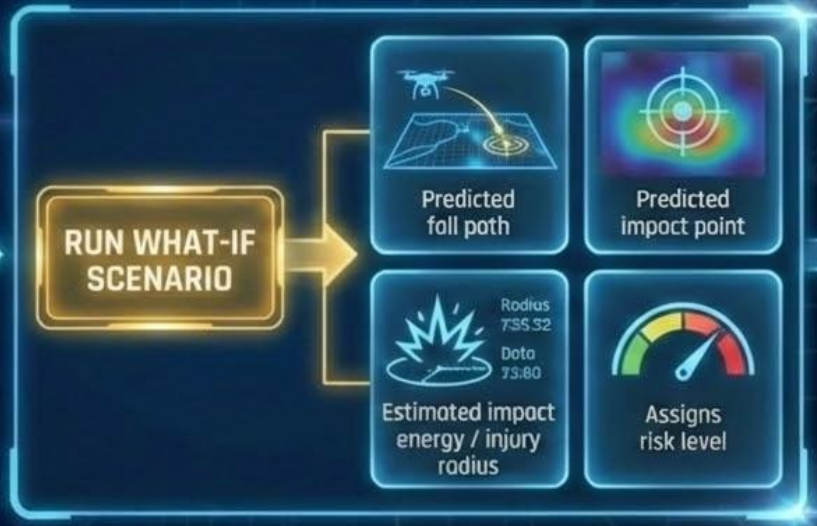
A scenario generator that predicts the consequences of a drone being neutralized at the exact moment the operator chooses.

1. Dynamic Flight

A drone flies dynamically in the 3D environment

2. Moment of Interest

The operator observes the drone and chooses a moment of interest



3. Run What-If Scenario

4. Final Risk Summary

The system ends with a final risk summary for the chosen “What-if” moment.

User Inputs

- Drone weight category
- Wind level
- Planned neutralization method (nice-to-have)

System Inputs (automatic)

- Current altitude
- Current velocity
- Drone coordinates

Output

- predicted fall path
- predicted impact point
- estimated impact energy / injury radius.
- risk level (low / medium / high)
- Recommended strike time (“wait 5.6 seconds to strike, reduces risk by 20%”)

“

The MVP does not simulate the drone actually being neutralized nor show the actual fall path. It provides a decision-support prediction that tells the operator what would happen if the drone were to be neutralized at a moment of their choosing.

STRETCH GOAL

A Stretch goal would be to simulate the actual fall path and compare it with the prediction summary.

Stretch goal - if time allows

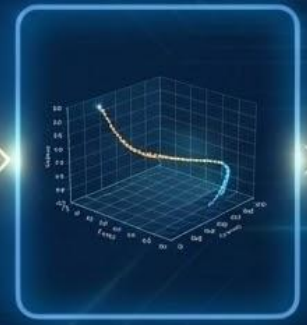
Mode 2 — Automated Validation Mode

Prediction: “Recommended wait time: 2.3 seconds”

1. Wait 2.3 seconds in simulation

2. Trigger neutralization

3. Actually drop the drone using Unity physics



4. Record the real fall path

5. Compare predicted damage vs. actual damage

Nice to Have

1. Real-world 3D terrain integration

- Enables terrain-aware risk predictions
- Avoids buildings, roads, critical infrastructure

2. Multiple neutralization methods

Different C-UAS actions → different descent patterns → improves prediction

Technologies

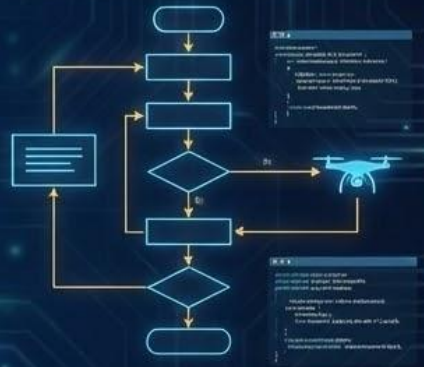
Unity 3D

- Simulation environment
- UI for operator controls

Cesium for Unity (Nice-to-Have)

- Real-world 3D terrain from Google Photorealistic Tiles
- Accurate geospatial positioning

C#



- Prediction algorithm logic
- Drone movement scripts
- Descent physics

Deliverable

1. Design Document

- Background research on drone threats & neutralization methods
- Technical approach and algorithms used
- Why certain technologies were chosen
- Limitations and assumptions
- Lessons learned

2. Working Demonstration

- A Unity-based simulation
- Dynamic drone flight + prediction overlays
- Predicted Impact footprint heatmap
- Risk score + timing recommendation

3. Source Code Repository

- Well-structured C# scripts
- Simulation logic
- Prediction algorithm
- UI and visualization components

4. Nice-to-Have Deliverables:

- Cesium + Google 3D Terrain integration
- Simulation of Actual descent (Validation mode)
- Multiple neutralization-mode physics
- Building-aware risk scoring

Future Directions

Full 3D holographic table version

Damage estimation visualization

(building-level impact consequence)

Possibly incorporate AirSim for advanced physics

For high-fidelity simulation

Timeline

Week 1 — Foundations

- Build Unity scene
- Implement drone wandering (random roam)
- Set ground-based operator camera
- Begin basic descent physics
- Define operator UI

Week 2 — MVP Algorithm

- Descent prediction formulas
- Impact point estimation
- Injury radius model
- Risk classification
- Visualize predicted fall

Week 3 — Simulation Polish

- Heatmap visualization
- Operator “Neutralize Now” button
- Timing recommendation logic