AI Based Landing Zone Safety Capstone Project

AI-Based Landing Zone Safety Classification Using Drone Imagery

Dataset:

https://docs.google.com/spreadsheets/d/1tCQf9YVzj8zET1bjTIettAV5WfyeNpo4EBEjo5H1Z9Y/edit?usp=sharing

Capstone Overview

In this capstone, you will design an end-to-end AI pipeline to classify drone landing zones as safe or unsafe using aerial imagery-derived features. The project focuses on feature-level terrain analysis (not raw image processing), machine learning classification, and spatial safety assessment to support autonomous and remote drone landing operations.

Dataset Provided

You are provided with a dataset representing tile-level features extracted from aerial imagery and elevation data. Each row corresponds to a spatial landing zone tile evaluated for landing safety.

Features include slope, surface roughness, vegetation indicators, obstacle density, shadow coverage, brightness variation, and detection confidence scores. Labels indicate whether a tile is considered safe or unsafe for landing.

Important: You are not expected to process raw images. The dataset simulates realistic outputs after perception, segmentation, and feature extraction pipelines used in drone autonomy.

Objectives

- Understand terrain and visual indicators affecting drone landing safety
- Apply machine learning for safety classification problems
- Evaluate model reliability using appropriate performance metrics
- Perform spatial aggregation for landing zone risk mapping
- Interpret AI outputs for autonomous drone decision-making

Capstone Tasks

Task 1: Data Understanding

Explore the dataset and explain the physical meaning of each feature and its relevance to landing safety assessment.

Task 2: Machine Learning Model

Train a classification model to predict landing zone safety. Evaluate performance using precision, recall, F1-score, confusion matrix, and ROC-AUC. Justify why accuracy alone is insufficient for safety-critical systems.

Task 3: Spatial Safety Analysis & Visualization

Aggregate predictions across spatial grid cells and generate a landing safety heatmap indicating preferred and restricted landing zones.

Task 4: Drone Autonomy Interpretation

Recommend landing strategies and fallback behaviors based on spatial safety patterns and confidence levels.

Task 5: Reflection

Discuss dataset limitations and propose improvements using real-time perception, multi-view imagery, or onboard sensing.

Deliverables

- Jupyter Notebook with code and outputs
- Landing zone safety heatmaps
- Short written technical interpretation