Visualizing Controlled Airspace with Augmented Reality

Supporting Drone Operators in Pre-Flight Navigation in the Post-Geofencing Era

Nicholas Charpentier

ABSTRACT

In January 2025, DJI, the world's leading drone manufacturer, removed geofencing from its DJI Fly app, replacing automated no-fly zones with enhanced warnings based on FAA data. This shift placed greater responsibility on drone operators to ensure safe and legal flights, particularly in controlled airspace. This capstone project addresses this challenge by developing an augmented reality (AR) tool to visualize 3D airspace zones around Prince Albert, Saskatchewan, accessible via smartphone browsers.

By leveraging GIS and AR, this prototype shows potential in enhancing pre-flight situational awareness, helping both recreational and professional pilots navigate complex airspace without relying on 2D maps or automated geofencing. This project demonstrates a practical, accessible solution for safer drone operations in the post-geofencing era.

WHAT IS GEOGRAPIC INFORMATION SYSTEMS AND HOW WAS IT USED IN THIS PROJECT?

Geographic Information Systems (GIS) is a powerful framework for capturing, analyzing, and visualizing spatial data to uncover patterns and relationships in the world around us. In this project, GIS was the backbone for creating a 3D airspace visualization tool tailored for drone operators. Using ArcGIS Pro, controlled airspace data from a visual flight rules (VFR) chart for Prince Albert, was converted into 2D buffer layers with Python scripting. These layers were then extruded into 3D cylindrical models, representing the controlled airspace zones around the city.

GIS enabled precise georeferencing and spatial analysis, ensuring accuracy in the models' dimensions and locations. By integrating GIS with AR, static aviation data was transformed into an interactive, real-world visualization, making complex airspace accessible to drone operators on their smartphones.

MATERIALS & METHODOLOGY

This project utilized a multi-step workflow combining GIS, 3D rendering, and AR technologies. Controlled airspace zones were first identified with a VFR chart from FltPlan.com and NRC Canada's "Drone Site Selection Tool", then digitized in ArcGIS Pro. Python scripting in ArcGIS Pro generated 2D buffer layers, which were extruded into 3D cylinders using airspace ceiling heights. These models were converted to multipatch objects, exported as .dae files, and refined in Blender for scale and visual clarity. Final .glb files were integrated into a browser-based AR app using AR.js and hosted on GitHub. Screenshots of the ArcGIS Pro and Blender workspaces have been documented below. Testing was conducted on an Android device in Google Chrome browser.

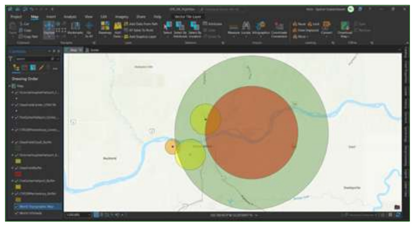

Figure 1. 2D airspace buffer zones created in ArcGIS Pro

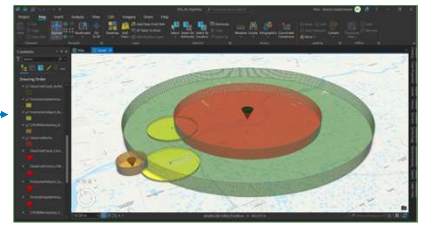

Figure 2. Controlled airspace buffer zones extruded by ceiling height in ArcGIS Pro 3D Local Scene

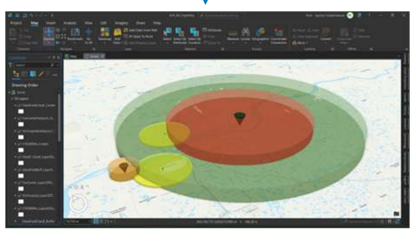

Figure 3. 3D airspace cylinders converted to multipatch objects

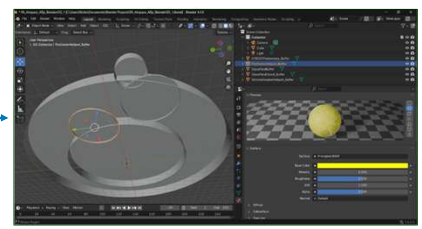

Figure 4. Airspace models imported into Blender, scaled and positioned geographically, before uploading to GitHub

RESULTS

The result of this project is a working prototype: a browser-based AR app displaying semi-transparent, 3D cylindrical airspace zones around Prince Albert, currently showcasing Victoria Hospital Heliport's controlled airspace. Accessible via a smartphone's camera, the app overlays color-coded 3D models onto the real world, allowing pilots to visualize airspace boundaries and ceilings intuitively. Despite a lack of prior AR development experience, this proof-of-concept was created in just a few months, using the innovative workflow described above. Testing in Prince Albert confirmed the app's functionality, though locational accuracy and model visibility require refinement. This prototype demonstrates the potential for AR to enhance pre-flight planning, offering a user-friendly alternative to 2D charts and fostering safer drone operations.

Figure 5. Cylindrical curvature of Victoria Hospital Heliport airspace

CONCLUSIONS

This project showcases the power of GIS and AR to address real-world challenges in drone navigation, post-geofencing. The prototype AR app offers a practical, smartphone-based solution for visualizing 3D airspace, making it easier for drone operators to comply with regulations and avoid violations. While the current version is limited to one airspace zone, it proves the feasibility of AR for enhancing situational awareness without complex hardware or 2D map interpretation. Future improvements will focus on refining model accuracy, adding features like runway approach paths, nearby aircraft notifications via ADS-B data scraping, and scaling to other regions. This work lays the foundation for safer, smarter drone operations, with potential to benefit both pilots and aviation authorities in an increasingly busy airspace.

AIRSPACE REFERENCE

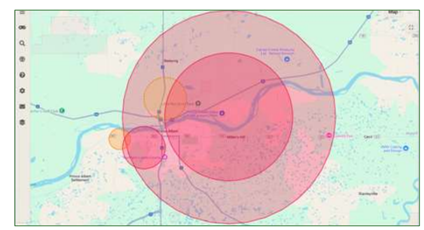

Figure 6. Map of controlled airspace in Prince Albert, SK, from nrc.canada.ca, which was referenced in this project

ACKNOWLEDGEMENTS & CONTACT

I extend my sincere gratitude to my GIS Instructors **Leila Benmerrouche**, who was my advisor for this project and worked closely with me in troubleshooting multiple issues, and **Ryan Galbraith** who inspired me to further pursue this topic.

For professional inquiries, or to view my growing GIS portfolio, please scan the QR code to connect with me on LinkedIn.