An On-Device AI System for Enhancing ATC Pilot Communications

Schwickert, Mikolas (School: ASU Prep Digital)

Safe and efficient aviation operations rely heavily on precise verbal exchanges between pilots and air traffic controllers (ATC). These exchanges are conducted via voice radio transmissions and are vulnerable to misunderstandings, noise, high workload, and accent or phraseology variations. As communication errors remain a dominant factor in runway incursions and other aviation safety incidents, there is a critical need for tools that improve clarity and accountability. This project introduces an embedded AI system that captures ATC or pilot radio audio, transcribes it in near real-time, provide visual feedback, distinguishes speaker roles (controller vs. pilot), and flags communications that are incomplete, ambiguous or unsafe. By placing this capability on-device, a Raspberry Pi based hardware unit, the solution seeks to enhance pilot and controller awareness without relying on network connectivity. Testing on real world ATC recordings demonstrated that the optimized audio enhancement pipeline improved transcription accuracy compared to baseline processing. Results showed measurable reductions in word error rate (WER), with the greatest improvements occurring when multiple filters where applied sequentially. The most effective pipeline combined 16kHz resampling, band pass filtering, notch filtering, spectral noise reduction, dynamic range compression, and RMS normalization, reducing the WER from 12.6% to 7.0%. Additionally, analysis revealed that accurately capturing critical numbers like altitudes, headings, and call signs was more significant than just WER alone.

Awards Won: