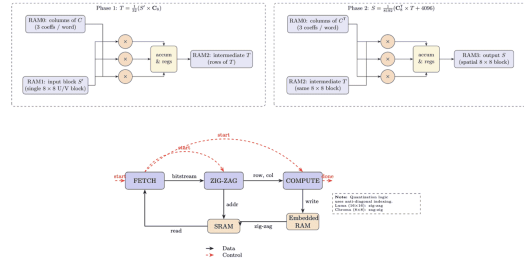
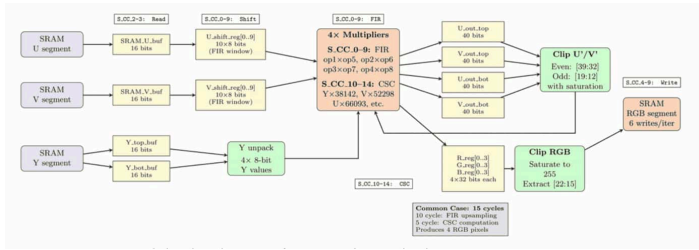
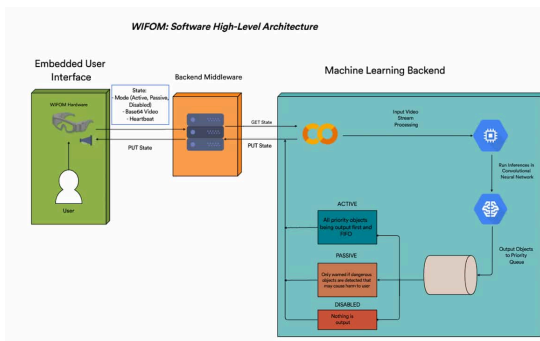


Hardware Image Decompressor, based on JPEG



- Architected an RTL image decompressor for a JPEG-like format achieving 88.89% hardware-constrained multiplier utilization at 50 MHz, implementing 10-tap FIR upsampling and YUV-to-RGB colour-space conversion with minimal stalls across the 192x144 image.
- Designed a 4-stage pipelined IDCT processor (FETCH → COMPUTE\_T → COMPUTE\_S → WRITE) with time-shared hardware multipliers across 325 blocks; implemented column grouping to maximize parallel computation throughput.
- Optimized the datapath architecture by deriving row/column indices combinationally from address counters and streaming final S-phase samples, eliminating redundant embedded RAM usage and reducing register overhead by 30%.
- Implemented a circular buffer architecture with dual-port embedded RAMs for concurrent multiply-accumulate operations, achieving timing closure with 3.282 ns slack while utilizing only 4% of target FPGA logic elements.
- Verified the RTL against a Python golden-reference model using unit-isolated testbenches, and a UVM environment with constrained-random stimulus and functional coverage targeting boundary conditions (row-edge chroma, clipping). Debugged VGA output through mismatch-address and ModelSim waveform tracing.
- **Technical documentation available [here](#)**

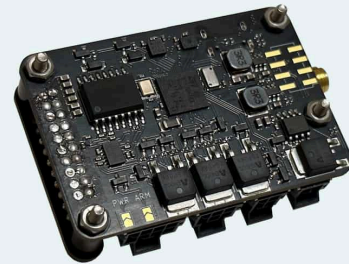
What's in Front of Me (WIFOM?) / Assistive Device for Visually Impaired



- Architected an end-to-end computer-vision pipeline for an assistive wearable device with dual ESP32-CAM modules, web-application middleware, and cloud-based ML inference backend, enabling real-time object detection and hazard identification for visually impaired users, all for under \$40 CAD.
- Developed a prioritized alert system with text-to-speech auditory feedback and haptic motor actuation based on threat classification (dangers, warnings, objects), enabling multimodal sensory substitution with <2 s latency from image capture to user notification.
- Implemented a RESTful API integration layer connecting embedded ESP32 image capture to a cloud ML service.
- Validated system robustness through field testing in high-density environments (crowds) and challenging lighting (direct sunlight), demonstrating reliable multi-object detection.
- **Technical slides available [here](#) and video demonstration available [here](#)**

# Portfolio

## McMaster Rocketry Team, Controls Project Manager

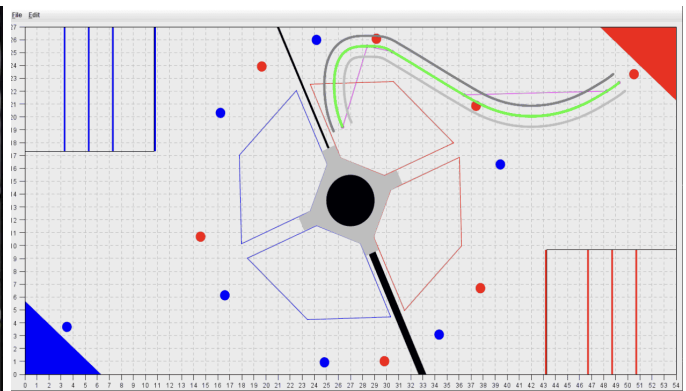
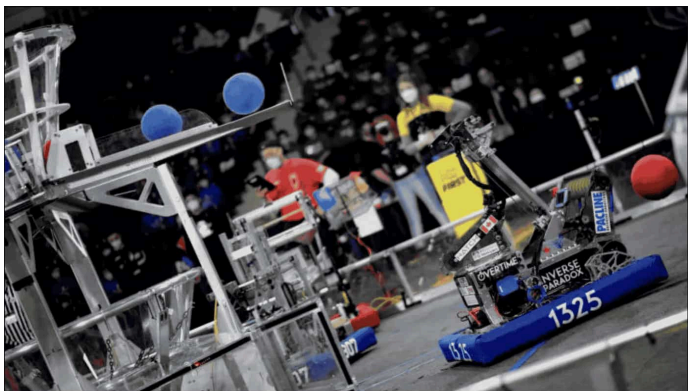


**Packed With High Performance Components**

STM32H723 MCU	64MB Storage
±16G / ±100G Dual IPU	Up to 30KM Barometer
>200KM Telemetry range	Magnetometer and GPS

- Led controls sub-team coordinating integration across 6 engineering sub-teams to develop SRAD avionics suite (VLF3 telemetry/DAQ + VL8 power/pyro/camera controller) with STM32 microcontrollers, barometer, and LoRa telemetry.
- Developed a visualizer displaying telemetry data with plots (battery voltage, acceleration, altitude), navball orientation display, and a view showing rocket location and speed relative to the launchpad.
- Co-authored IREC Spaceport America Cup 2023 Project Technical Report documenting avionics architecture, sensor integration, and assembly/preflight/recovery checklists for competition submission.
- Contributed to avionics design supporting future active control extensions through sensor fusion with Kalman filter implementation for powered flight state estimation.
- **Technical documentation available [here](#) and video of launch available [here](#)**

## FIRST Robotics Team 1325 – Inverse Paradox, Software



- Architected autonomous navigation with path following and encoder/gyro feedback enabling shooting while moving; implemented Limelight vision processing with trigonometric calculations and cached position tracking maintaining target lock during sensor dropout.
- Designed a state machine for an 11-second automated climb with pitch-based transitions and soft stops, implementing trigonometric feedforward gravity compensation.
- Developed a vision-guided turret with interpolated RPM speed map and OpenCV colour detection enabling automatic cargo rejection.
- **Technical documentation available [here](#) and video of a match available [here](#)**