

DAVID NKWO

ROBOTICS & PHYSICAL AI ENGINEER | SYSTEMS ARCHITECTURE, AUTONOMY & TECHNICAL LEADERSHIP
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PROFILE

Robotics and Physical AI engineer with a University of Toronto MEng in Robotics, AI & Data Analytics and a mechanical engineering foundation. Works across ROS 2 autonomy, robot perception, physical hardware integration, systems architecture and technical product development, translating operational problems into requirements, interfaces, technical roadmaps and validation plans. Combines independent robotics systems consulting and completed physical robot bring-up with 4+ years of technical leadership in real-world, high-reliability environments. Approaches robotics as an end-to-end systems problem: define clear interfaces, instrument behaviour, validate failure modes, preserve bounded recovery/fallback paths, and expand autonomy only when measured capability supports it.

CORE TECHNICAL & LEADERSHIP CAPABILITIES

Robotics & Autonomy	ROS 2 Humble, Nav2, AMCL, TF/tf2, URDF/xacro, robot_state_publisher, Gazebo, RViz, occupancy grids, costmaps, task logic, recovery, MoveIt 2/OpenManipulator concepts
Hardware & Integration	Arduino/MCU firmware, PWM servo control, serial protocols, command validation/acknowledgements, calibration, joint limits, watchdogs, timeouts, diagnostics, safe-state behaviour, physical bring-up
Perception & Physical AI	OpenCV, YOLOv8, ResNet18, OCR/Tesseract, ArUco pose estimation, Grounding DINO, OWL-ViT, GPT Vision, visual grounding, tracking, semantic localization, confidence/safety gating
Architecture & Leadership	Requirements definition, subsystem/interface design, build-vs-buy and component trade studies, sensing/compute selection, phased execution roadmaps, integration strategy, verification/validation, commissioning, reliability, failure analysis
Software & AI	Python, C++, Linux/Ubuntu, Git/GitHub, PyTorch, TensorFlow/Keras, NumPy, Pandas, scikit-learn, structured logging, reproducible testing, reinforcement-learning foundations

PROFESSIONAL EXPERIENCE

Independent Robotics Systems Consultant | Robotics Systems & Product Development

- Toronto, ON | 2026-Present
- Support early-stage robotics and automation initiatives through technical feasibility, requirements definition, system architecture, prototype planning and implementation strategy across mobile robotics, manipulation, perception, controls, ROS 2, reliability and Physical AI.
 - Translate product concepts and operational workflows into hardware/software requirements, subsystem designs, sensing/compute needs, cost/risk assessments, build-vs-buy decisions, platform/component selections and phased development roadmaps.
 - Define integration and prototype-validation strategies that surface high-risk unknowns early, establish measurable gates, and guide projects from concept toward subsystem validation and deployable systems.

Technical Lead II | Encore Canada

- Toronto, ON | Sep 2025-Present
- Own integration, deployment, validation and operation of interconnected hardware/software systems in high-availability live environments spanning compute, networking, control, cameras, signal/data flow, communications, displays and operator interfaces.
 - Lead architecture and deployment planning, coordinate technicians/vendors/clients, make real-time technical decisions during failures, and standardize readiness, recovery, troubleshooting and handoff procedures.

Technical Supervisor - Fairmont Chateau Laurier | Encore Canada

- Ottawa, ON | Apr 2025-Aug 2025
- Led concurrent technical deployments for corporate, government, executive and VIP environments, coordinating teams of approximately 8-15 technicians while planning equipment, integration, testing, readiness, troubleshooting and recovery.
- Earlier Encore role: Audio Visual Technician - Fairmont Chateau Laurier | Nov 2022-Dec 2023

Technical Systems Integrator - AV & Event Technology | AV Lockup / Independent

- Canada | Sep 2024-Present
- Design and commission complete technical systems for independent clients, translating requirements into architecture, equipment selection, interfaces, signal/data flow, networking, configuration and validation plans.
 - Perform functional testing, fault isolation, recovery, documentation, user training and post-deployment support across cameras, compute, networking, control, communications, displays and broadcast infrastructure.

Lead Technician | Event & Broadcast Technology | Baldwin Studio

- Ottawa, ON | Jan 2024-Mar 2025
- Integrated interconnected camera, networking, control, communications and broadcast systems; led freelance crews on selected deployments through setup, testing, readiness, issue resolution and live technical recovery.
 - Built practical field experience in systems integration, deployment reliability, fault isolation and real-time technical decision-making while remaining a hands-on senior technician.

Technical Director | Audio, Visual & Event Technology | RCCG Faith Chapel

- Orleans, ON | Jun 2022-Mar 2025
- Directed recurring technical operations and integration across cameras, networking, control, livestreaming, displays and supporting infrastructure; designed repeatable system architectures and testing/troubleshooting workflows.
 - Trained technical teams and maintained long-term ownership of equipment readiness, operating standards, system reliability and continuous improvement.

SELECTED ROBOTICS & PHYSICAL AI WORK

Physical AI Autonomous Delivery Robot | Independent R&D Capstone

2026-Present | IN PROGRESS - SYSTEM DEFINITION & PRE-BUILD

- Architected the planned end-to-end mobile-manipulation system across mobile base, manipulator, RGB/RGB-D perception, LiDAR/depth sensing, odometry, ROS 2 interfaces, navigation, visual grounding, manipulation, safety/recovery, observability and later robot-learning pathways.
- Completed requirements definition, subsystem/interface planning, hardware/platform selection, parts specification, sensing/compute planning, build-vs-buy analysis, cost/risk trade-offs and a phased technical execution roadmap.
- Selected the current platform direction around a Hiwonder MentorPi A1 Advanced mobile base, Raspberry Pi 5 compute and Hiwonder NexArm manipulator; final-platform physical implementation is the next stage.

ROS 2 Hardware Integration & Robotic Arm Bring-Up | Adeept Pre-Capstone Sprint

2026 | PHYSICAL ROBOTICS - COMPLETED

- Brought up and validated a physical servo-driven arm from safe power-up and calibration through ROS 2 command execution, implementing joint mapping, conservative limits, home positions, servo offsets and bounded actuator commands.
- Implemented and tested the command path ROS 2 -> C++ driver/hardware interface -> serial protocol -> MCU firmware -> PWM servo actuation, with acknowledgements, malformed/stale/out-of-range command rejection, timeouts, watchdogs and defined reset/communication-loss behaviour.
- Built URDF/xacro, TF and robot_state_publisher integration; published /joint_states explicitly as open-loop commanded estimates, and recorded diagnostics, timing, calibration/configuration state and repeatability/backlash observations with reproducible recovery procedures.

Adaptive Visual Grounding for Robot Vision | Public GitHub + Live Streamlit App

2026 | DEPLOYED - ROBOT PERCEPTION

- Built and deployed a robot-vision service that converts natural-language target descriptions plus image/video/live-camera inputs into localized targets using YOLO, OWL-ViT, GPT-guided routing, OpenCV tracking, structured outputs and confidence/timing traces.
- Benchmarked four grounding approaches on 105 corrected residence images; strongest guided configuration reached 0.473 mean IoU, 0.573 median IoU, 78.1% success at IoU >= 0.25 and 57.1% at IoU >= 0.50; public package validated with 44 automated tests.

Autonomous Delivery Robotics | University of Toronto

2025-2026 | ROS 2 - AUTONOMY - PERCEPTION - MANIPULATION

- Engineered a multi-phase ROS 2/Gazebo/TurtleBot3 programme integrating Nav2 navigation, AMCL localization, TF/costmaps, OCR, ArUco pose estimation, YOLOv8 perception, elevator interaction, semantic localization and simulated manipulation.
- Elevator safe-entry logic achieved 100% trigger success and zero false-positive entry triggers in tested simulation conditions; ResNet18 semantic localization reached 0.778 test accuracy across nine indoor place labels.

Vision-Language Model Evaluation Pipeline | Public GitHub

2026 | MULTIMODAL AI - DATA SYSTEMS

- Built a reproducible PySpark/Parquet pipeline standardizing 10,301 ScienceQA rows and 1,000 VMCBench rows into a shared image-QA schema with validation, model interfaces, result tables and heatmaps.
- Evaluated BLIP-2 and InstructBLIP across 11,301 items per model using answer-ranking/loss scoring; InstructBLIP reached 49.11% weighted accuracy versus 45.16% for BLIP-2.

SELECTED SYSTEMS ENGINEERING CASE STUDY

Church AV, Broadcast & Livestream Integration | Independent Client System

SYSTEM DESIGN - PROCUREMENT - INSTALLATION - COMMISSIONING

- Scoped, procured, installed and integrated a complete audio, video, display and livestream system while wider building infrastructure was still being completed, sequencing technical work around changing site access and other active trades.
- Translated operational needs into subsystem architecture and equipment decisions across sanctuary displays, LED video, PA/monitoring, microphones, PTZ cameras, OBS livestreaming and supporting network/control infrastructure; commissioned routing, camera configuration, service audio and live operation under deadline pressure.

ADDITIONAL TECHNICAL WORK

Human-aware robot architecture; CLIP vs Grounding DINO visual-grounding benchmark across 1,150 test pairs; RL implementations spanning DP, Monte Carlo, SARSA, Q-learning, Tree Backup and REINFORCE; cloud/distributed ML work across Spark/PySpark, Hadoop, Azure Data Factory, Stream Analytics, IoT and Azure ML.

ENGINEERING APPROACH

Measured capability: a command being accepted is not the same as the physical outcome being verified. Bounded autonomy: intelligent behaviour should operate inside explicit capability, safety, recovery and fallback boundaries. Progressive complexity: increase task and environmental complexity only after the underlying capability is sufficiently reliable.

EDUCATION

Master of Engineering, Mechanical Engineering | University of Toronto | Robotics, AI & Data Analytics

Completed Aug 2026

Bachelor of Applied Science, Mechanical Engineering | University of Ottawa

2022