AN AI PLATFORM TO DELIVER HUMAN-LIKE REASONING & AUTONOMY FOR COMMERCIAL AND DEFENSE APPLICATIONS

March 18, 2024

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PALLADYNE AI AT-A-GLANCE

NASDAQ

STRC

Robotics DNA

30+ years in robotics and robotics software. Legacy leadership in dexterous mobile robot business across aviation, construction, energy, and defense sectors

Experience

30+ years of robotics engineering excellence. Technology team led by CTO with 25+ years of AI/ML expertise

Salt Lake City, UT

Innovation and operations

60+

team members, world-class robotics & AI/ML software engineers

PALLADYNE AI: 30+ YEARS OF INNOVATION AND EVOLUTION

Government/DoD R&D

Dexterous Robotic Systems

Purpose-Built Solutions

AI Software

1983 — Sarcos spins out of University of Utah (1983)

2007 — Raytheon buys Sarcos (2007)

2015 — Purchase from Raytheon (2015)

2019 — Start AI/ML Software Development (2019)

2021 — Sarcos Robotics starts trading - STRC (2021)

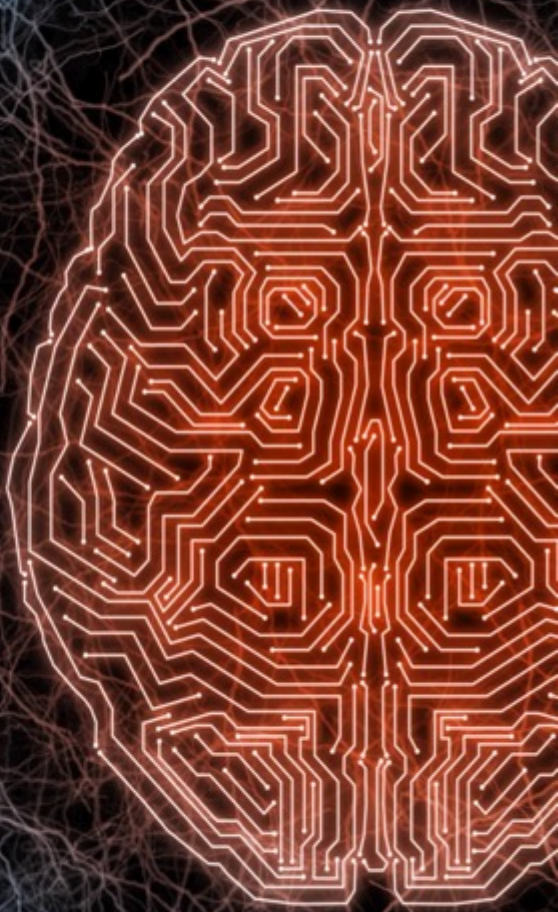
2023 — New AI software focus (2023)

2024 — Sarcos becomes Palladyne AI

2024 — Anticipated AI/ML Software Framework Launch and Customer Trials

OUR VISION: TO ENABLE MACHINES TO OBSERVE, LEARN, REASON AND ACT LIKE HUMANS

- Substantially accelerate speed of programming and training
- Increase agility, task sets and use cases
- Reduce need for human intervention and oversight
- Reduce cost of standing up and maintaining automation
- For mobile machines, evolve from human-in-the-loop to human-on-the-loop
- Eliminate need for continuous cloud connectivity



PALLADYNE AI TACKLES SOME OF THE BIGGEST CHALLENGES IN ROBOTICS

- Implementation of industrial robotics can take a long time and be very costly
- Most industrial robots are highly programmed for a specific task
- Today's AI approaches (e.g., LLM[1] for generative AI) require vast amounts of training data and are power hungry
- Sensors are generally discrete and not optimized to work in unison or to adapt and adjust for lost functionality of a single sensor

1. Large language models.

ENABLE MACHINES TO OBSERVE, LEARN, REASON AND ACT LIKE HUMANS

REAL-TIME CLOSED-LOOP AUTONOMY SOLVES TASKS FOR DYNAMIC AND UNSTRUCTURED ENVIRONMENTS

Commercial Robots

+

Hardware-agnostic, real-time closed-loop autonomy software solution

Addresses key challenges in traditional robotic deployments:

- High cost and complexity of programming and deployment
- Unsafe and inefficient operations in unstructured and dynamic environments
- Point solutions unable to learn and adapt in real time, require re-training to perform new or modified tasks

AI FOR THE REAL (PHYSICAL) WORLD

MOST AI TODAY LIVES IN THE DIGITAL WORLD

Digital World AI/ML Approach

- Objective is to *predict outcomes* and make recommendations to empower humans - make more efficient, make better decisions, optimize processes, develop new products, etc.
- Harnesses enormous amounts data utilizing significant cloud-based computing to gather, ingest, integrate, analyze and learn from data

Palladyne AI's Real-World AI/ML Approach

- Objective is to *enable machines* to effectively operate autonomously in real world environments (structured, dynamic, and unstructured)
- Algorithms enable machines to react to changing circumstances and complete tasks without re-training or reprogramming
- Requires less data – uses on-robot[1] compute to ingest, integrate (fuse), analyze, learn, and react to changing circumstances without connecting to the cloud

"The key for us is enabling autonomy in an unstructured environment that can dynamically change. We focus on generalized autonomy, providing closed-loop functionality to adapt to tasks continuously."

- Denis Garagić, Chief Technology Officer, Palladyne AI

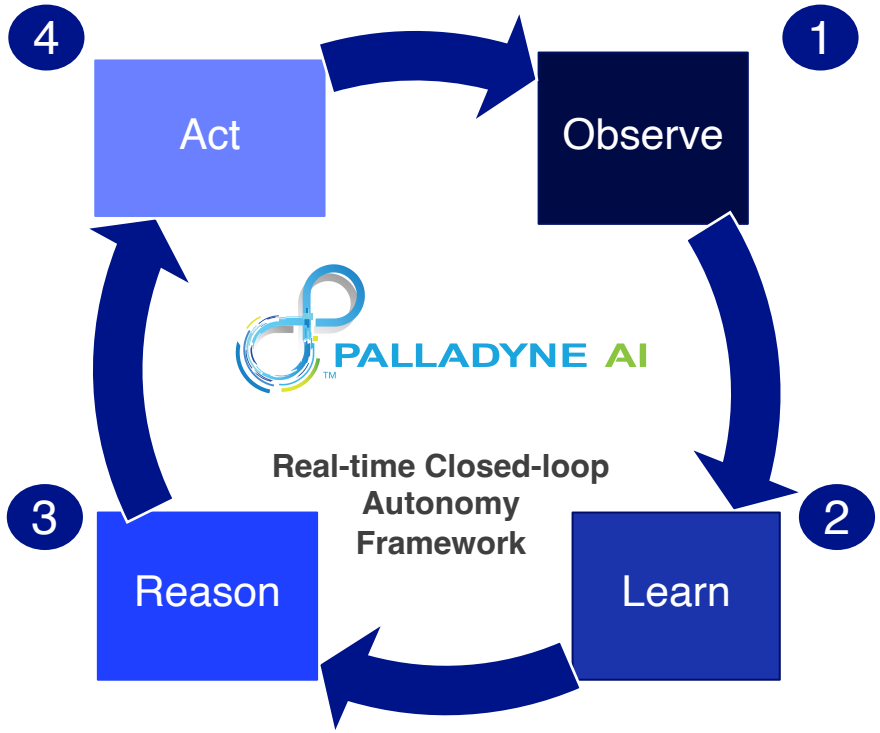
1. Occurs on the robot without a connection to the cloud.

PALLADYNE AI: AI/ML SOFTWARE PLATFORM

REAL-TIME CLOSED-LOOP AUTONOMY FRAMEWORK TO ENABLE MACHINES TO OBSERVE, LEARN, REASON, AND ACT LIKE HUMANS

- Closes the autonomy loop by applying human-like reasoning to determine the best course of action; completes the task
- Control manipulator arm, robot and / or end effector
- Achieve goal in a stable, safe, and controlled manner

- Adapting to unexpected events
- New motion plan based on observations

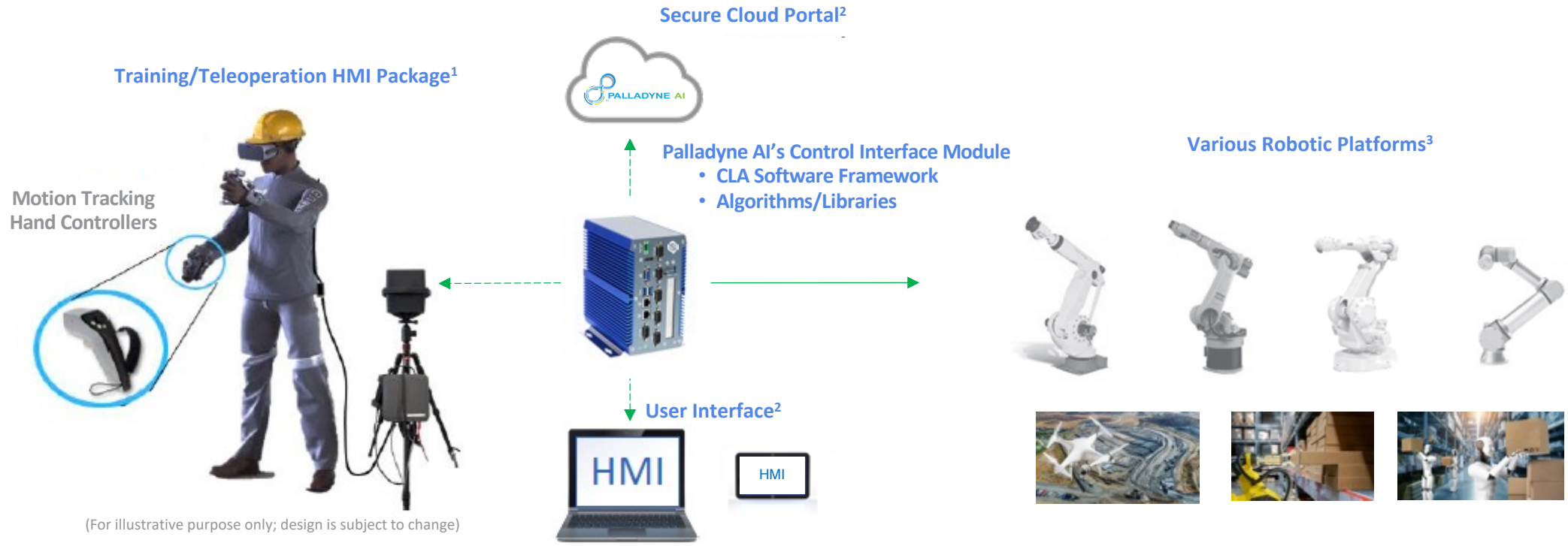


- Perceives environments with different sensor modalities e.g., vision, LiDAR, Radar, acoustic, etc.
- Utilizes Multi-Modal Sensor Fusion to make perception more robust to sensor occlusion and noise
- Improves Situational Awareness (SA)

- Learning occurs with minimal demonstrations (1-5)
- Dynamic Reasoning and Learning for novel task combinations or entirely new tasks
- Model adaptation to specific environments

Real-time perceiving, learning & decision-making occurs on-robot without retraining or cloud connectivity

PALLADYNE AI: AI/ML SOFTWARE PLATFORM FOR ROBOTICS



(For illustrative purpose only; design is subject to change)

Designed to Maximize System Flexibility, Adaptability, Mobility, and Learning

Connection not required for autonomous robot operations

1. Certain teleoperation devices may not be included as part of our sales package.
2. Laptops are not sold as a part of the system; assumes customers will source separately or use existing company assets.
3. Designed to work with most industrial robots being sold today. According to the Proficient Market Insights' "Global Robot Operating System" report, ROS 1 robots comprised of 74% of the total ROS market in 2021, "Global Robot Operating System (ROS) Market 2022 Size Of $ (globenewswire.com)

EXPECTED ADVANTAGES OF OUR AI/ML PLATFORM

HOW OUR APPROACH DIFFERS

- Hardware agnostic[1]
- Addresses robotic-specific challenges beyond integration
- Solves for system stability and pose estimation/end effector orientation
- Solves long-horizon tasks in arbitrary human environments

- Fuses multi-sensor data inputs together to improve system flexibility & adaptability
- Flexible instructional input options for task model learning (i.e., LLMs, DSLs[2], motion-capture-based teleoperation, AR/VR, video input, etc.)
- Can provide language-to-motion instructions ideal for edge computing/robotics applications; doesn't require cost/latency associated with use of LLMs requiring connectivity to the Cloud

- Full stack, closed-loop autonomy enables adaptability to dynamic changes in environment or defined task without human intervention or reprogramming
- Uses probabilistic machine learning (ML) techniques to learn the task, accounting for uncertainty and variability
- Dynamic model inference methods require much less training data; robots can learn to generalize with only a few demonstrations (1~ 5)
- Computational efficiencies gained through use of Palladyne AI's domain-specific language models

- Complex task learning capabilities are similar to humans; in some cases, we believe robots can be trained in orders-of-magnitude less time than it takes relying on current state-of-the-art approaches[3]
- Enables on-device computing; lower total cost of ownership (TCO) with no need to incur recurring cloud services costs
- Improves system implementation and startup times

1. Designed to work with most industrial robots being sold today. According to the Proficient Market Insights' "Global Robot Operating System" report, ROS 1 robots comprised of 74% of the total ROS market in 2021, "Global Robot Operating System (ROS) Market 2022 Size Of $ (globenewswire.com)
2. Domain specific languages.
3. Robotics Transformer 1 & 2 deep learning-based approach, 2022 – 2023.

HARDWARE AGNOSTIC[1]

EXPECTED TO ENABLE STATIONARY AND MOBILE ROBOTIC PLATFORMS TO BE AGILE AND AUTONOMOUS, REDUCE HUMAN INTERVENTION AND INCREASE ROI

Industrial Robots and Cobots

Unmanned Aerial Vehicles

Unmanned Ground Vehicles and Humanoids

1. Designed to work with most industrial robots being sold today. According to the Proficient Market Insights' "Global Robot Operating System" report, ROS 1 robots comprised of 74% of the total ROS market in 2021, "Global Robot Operating System (ROS) Market 2022 Size Of $ (globenewswire.com)

BENEFITS OF COMPUTING ON THE EDGE

Traditional AI / ML Product Solution (Cloud Compute[1,2])

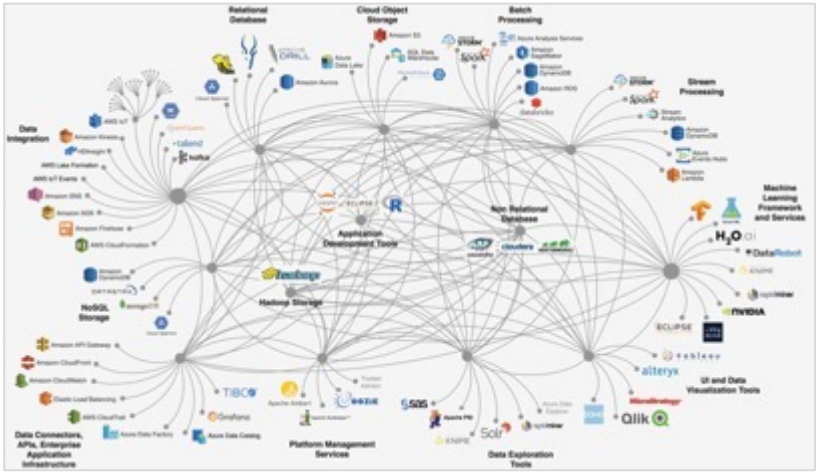
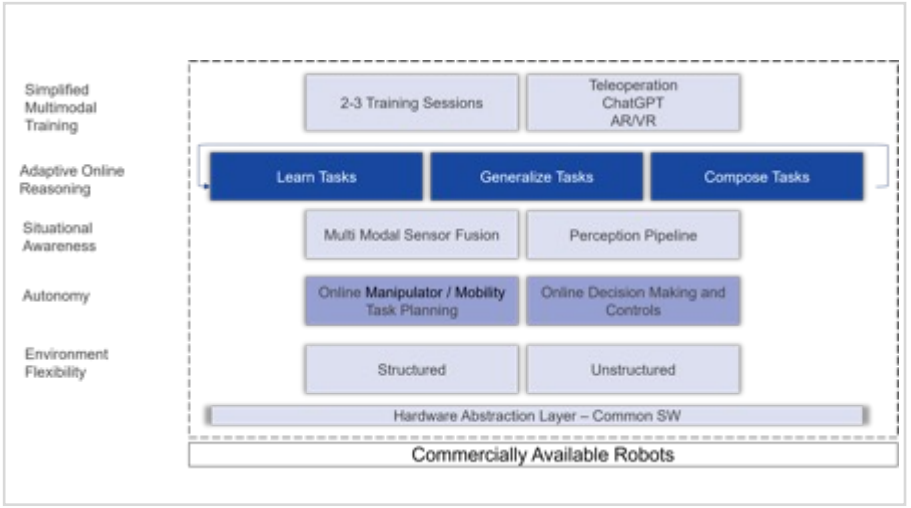


Photo Source: c3.ai

- Complex extremely large data set integration
- Enormous amounts of cloud compute required
- Predict outcomes, make recommendations driven by large data sets and models
- Humans utilize in decision making, process improvement and optimizations

VS.

Closed-Loop Autonomy for Robotics (Edge Compute)



- Environmental, situational awareness data from local workspace, more constrained (domain specific approach)
- On robot real-time human like reasoning applied to base models based on unexpected events
- “Closed loop” – adapting to those events real-time and update base models without retraining
- Structured and unstructured environments without retraining

1. C3.ai: A Full-Stack IoT Platform for Everyone
2. The Gordian Knot of Structured Programming (c3.ai),

HIDDEN COSTS OF POWER-HUNGRY AI APPROACHES

HOW IT'S DONE TODAY

Photo Source: FreePik

"You'll be astonished how much power it takes to generate a single AI image[1]"

Stable Diffusion's open-source XL model used almost as much power per image as that required to fully charge a smartphone

CO_2

Creating 1,000 images using same model generated CO2 emission equivalent of 4.1 miles driven by a gas-powered car.

AI

Power usage by AI servers on a global scale is equivalent to what Argentina uses in 1 year.

AI

Google reported[1] it used 5.6 billion gallons of water to cool their AI servers in 2022 (20% increase over 2021).

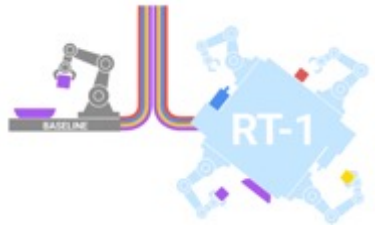


Photo Source: Google Research

"RT-1: Robotics Transformer for real-world control at scale[2]"

Example: Model trained on real-world robotics dataset:

- 130k episodes
- 700+ tasks
- collected from 13 robots over 17 mos.

"RT-2: Vision-Language-Action Models[3]"

"….the model size: 5B vs 55B for the RT-2 PaLI-X variant.."

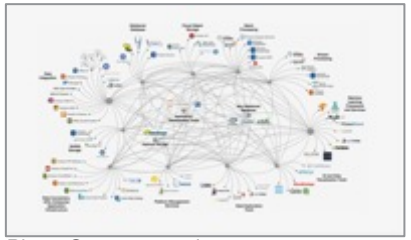


Photo Source: c3.ai

"The Gordian Knot of Structured Programming[4] "

"The 'build it yourself' approach requires numerous integrations of underlying components that were not designed to work together, resulting in a degree of complexity that overwhelms even the best development teams."

1. Futurism.com
2. Google Research Blog
3. robotics-transformer2.github.io
4. c3.ai

POTENTIAL USE CASES

Examples based on discussions with potential customers

MANUFACTURING

SUB PARTS ASSEMBLY[1]

STRUCTURED MANUFACTURING LINE, TASK VARIABILITY

TASKS & CHALLENGES

Changes in production line (products, fixes, updates) come at high cost – robot retraining and manufacturing downtime

OPPORTUNITY & EXPECTED BENEFITS

Low cost/quickly able to repurpose manipulators/ robots to perform new task. Minimal production downtime for new task training.

Employee can train in AR, deploy models across robots quickly

Quickly adapt to varying tasks on a multi-product assembly line set up

- Run assembly lines with mixed products to meet demand
- Robots automatically adapt tasks to be performed based on object detected)

Provides flexibility & future proof task planning; extends usability & life of robot

1. Potential use cases based on discussions with potential customers.

CONSTRUCTION

BUILD & REPAIR STEEL STRUCTURES[1]

UNSTRUCTURED, GROUND-LEVEL/AT-HEIGHT, IN-DOOR/OUT-DOOR, HEAVY TOOLS

TASKS

Identify and torque bolts to spec on large steel structures; bridges, buildings, manufacturing facilities, etc.

Inspection and repair of damaged bolts, moving/aligning/securing steel beams (a.k.a. Cooning)

CHALLENGES

Highly unstructured environment + at-height risks

Level of precision and speed required not achievable with teleoperation

OPPORTUNITY & EXPECTED BENEFITS

Precision detection of bolts and placement of tool. or traditional training models.

Adapt to varying environmental conditions at height to complete job

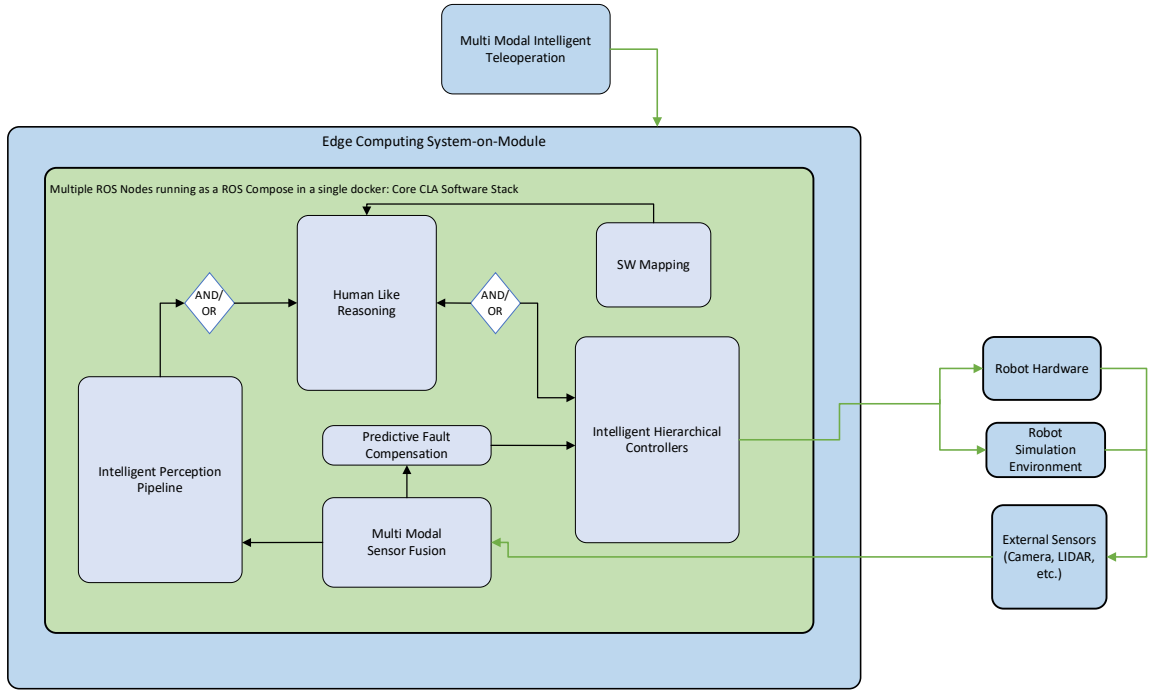
Operate safely as environment changes to ensure safety of personnel – reduce risks associated with at-height work in inclement weather.

1. Potential use cases based on discussions with potential customers.

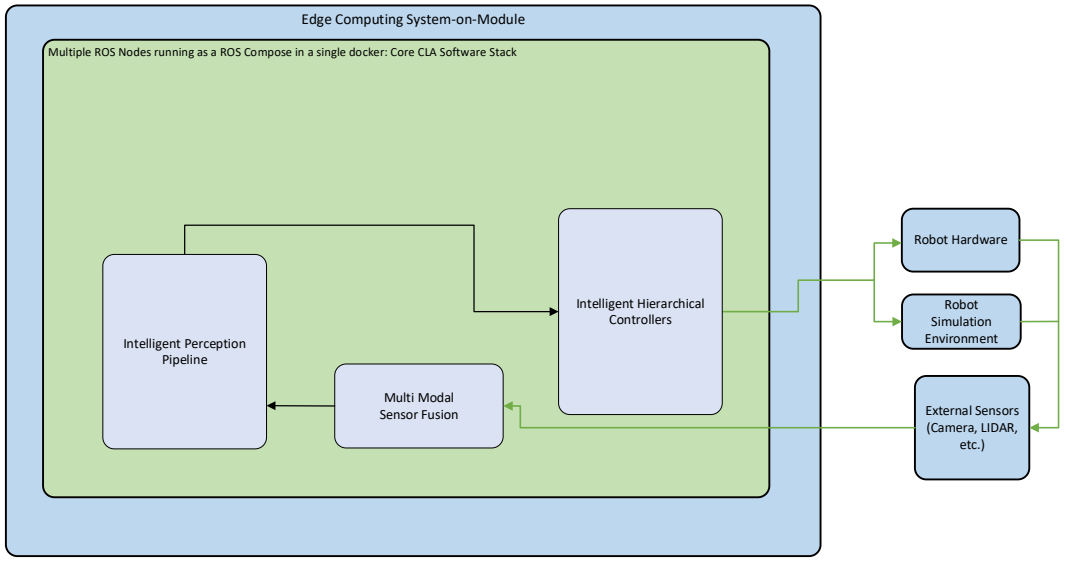
ENABLING ROBUST SITUATIONAL AWARENESS, AUTONOMOUS DETECTION/TRACKING AND CONTROL OF UAVS & UGVS

LEVERAGES FOUNDATIONAL CAPABILITIES OF THE AI/ML SOFTWARE FRAMEWORK

AI/ML Software Framework
(Full Stack Closed-Loop Autonomy)



Situational Awareness, Autonomous Detection/Tracking & Control[1] Framework
(Leverages a subset of the AI/ML Software Framework)



1. Control of sensors only; does not control UAV/UGV's flight or navigational functionalities.

DEFENSE / COMMERCIAL

UNMANNED AERIAL VEHICLES[1]

UNSTRUCTURED, IN-FLIGHT

TASKS

Persistent detection, tracking, and classification

CHALLENGES

Highly unstructured environment – in flight

High levels of uncertainty

OPPORTUNITY & EXPECTED BENEFITS

Persistent sensor-based detection, tracking & classification resolves representation uncertainty and enhances situational awareness

Shared situation and / or navigation across UAVs enhances the collective knowledge and understanding of the entire fleet

1. Potential use cases based on discussions with potential customers.

PALLADYNE AI CORP. FINANCIAL POSITION

PALLADYNE AI CORP. FINANCIAL POSITION

Year-End Cash Balance[1]	Expected Net Monthly Cash Usage per Month for 2024[2]	Shares Outstanding[3]
$39.1 million	$1.6 million/mo.	25,877,865 shares

1. As of December 31, 2023; includes all cash, cash equivalents and marketable securities.
2. For continuing operations, monthly and quarterly cash usage will vary; represents average monthly change in cash, cash equivalents and marketable securities.
3. As of December 31, 2023.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