



Modular Inspection Robot for Harsh Environments

ID# 2024-031

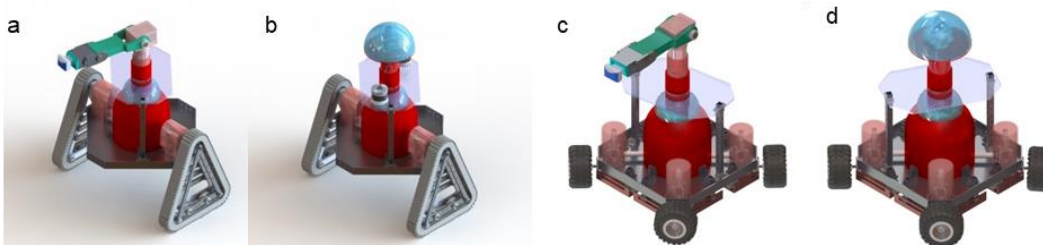
HIGHLIGHTS

- Cutting-edge, autonomous robot with a modular design, capable of flexible movement and equipped for both visual and non-destructive testing (NDT) inspection modes.
- The engineered robot can operate in extreme fluctuating outdoor hot/cold temperature conditions.
- Potential application in inspection across various industries, including construction, and oil & gas.

OPPORTUNITY

Inspection robots are vital in the oil and gas industry, the largest sector requiring automated surveillance due to its hazardous and extreme conditions. These robots face challenges in autonomy and reliability, especially in Canada's harsh climates where temperatures can reach $-40\text{ }^{\circ}\text{C}$ in the northern region. The industry's infrastructure, including pipelines and storage tanks, must be regularly inspected and maintained to prevent damage from high pressure, temperature, vibration, and humidity. Current robotic systems lack the capability to conduct thorough inspections for damage in severe outdoor conditions, particularly in harsh winter environments with snow-clad landscapes and low temperatures.

University of Alberta researchers have developed a new mobile robot design that is highly modular and can be reconfigured into four different models: tracked with the robot arm, tracked with a camera PTZ mechanism, omni-wheeled with robot arm, and omni-wheeled with PTZ mechanism. With four different types of robot configurations, it is able to perform both visual and NDT type inspection interchangeably, navigate over all kinds of outdoor terrains, move in tight spaces, and inspect various objects such as pipelines, vehicles, infrastructure, plants, and equipments, and operate in extreme temperatures ranging from $-40\text{ }^{\circ}\text{C}$ to $60\text{ }^{\circ}\text{C}$.



Different robot design configurations with; (a) robot arm and tracks; (b) PTZ mechanism and tracks; (c) robot arm and omni-wheels; (d) PTZ mechanism and omni-wheels.

COMPETITIVE ADVANTAGE

- The robot's mechanical and electrical components can withstand severe winter conditions, ensuring operability at temperatures as low as $-40\text{ }^{\circ}\text{C}$.
- Tracks enable robot mobility over up to 30 cm of snow, and the omni-wheeled robot configuration enables inspection in tight spaces such as underneath a haul truck.
- PTZ mechanism for the CCD camera facilities visual inspection in pitch and yaw directions.
- NDT type sensor can be mounted on the robot arm's end-effector, allowing its orientation to be adjusted in both the pitch and yaw directions.

STATUS

- Patent Pending.

INVENTORS

- [Rafiq Ahmad](#), Misha Afaq

MORE INFORMATION

- **Robert Carruthers**
Associate Director, Technology Transfer Services, University of Alberta
rwcaruthers@ualberta.ca, 825.601.5559
- **Dr. Rafiq Ahmad**
Associate Professor, University of Alberta
Rafiq.Ahmad@ualberta.ca, [SMART LABORATORY](#)