

Your Guide to Automating Industrial Inspection

Putting agile mobile robots to work for hazardous and tedious jobs



BostonDynamics



As operations manager of a power plant at a large electric utility, Darryl Lewis is used to thinking on his feet. When routine inspections turn up issues he must assess the situation quickly and devise a response plan that avoids costly downtime while maximizing safety.

Getting eyes on potentially hazardous areas is not easy, however, especially when taking thermal readings or detecting gas leaks requires access in close proximity to the problem. For this, Darryl turns to what he considers his new best friend - Spot, the canine-inspired robot from Boston Dynamics.

Roles and responsibilities like Darryl's are rapidly undergoing change for the better. Modern mobile robots are becoming more nimble, versatile, and rugged than before, making them increasingly capable of taking on undesirable and unsafe tasks.

In addition to improving working conditions for people, robots can provide operational intelligence that results in efficiency gains and reduced maintenance costs for the business.

Perhaps none is as distinctively designed and uniquely functional as Spot. Launched in 2019 for early adopters, it became commercially available for industrial markets in mid-2020. Already, the agile four-legged helper is delivering value in substations, power generation sites, oil and gas refineries, offshore rigs, manufacturing plants, mines, construction yards, and other asset-intensive environments.



Example Autonomous Readings



Gauge readings



Thermal inspection



Leak detection



Radiation detection



Noise anomaly detection



Crack detection



SF6 gas detection



Instability detection

Designed with Business Value in mind

Spot's remote inspection and autonomous data collection capabilities have firms across a number of industrial verticals using the robot to automate rounds and readings, conduct continuous condition monitoring, track inventory, build site maps, and assume hazardous area duties.

By equipping Spot with a laser scanner, firms are also using it to automate the process of creating and updating digital twins, accelerating digital transformation. With potentially expansive access to sensor data, Spot can support predictive and prescriptive maintenance and continuous improvement.

The robot's uniquely purposeful design allows it to succeed where other automation alternatives have failed.

As plants, utilities, and facilities explore and validate Spot's business value, many quickly set their sights on additional areas of the enterprise.

Each proven use case helps to advance the foundational goals of safety, reliability, efficiency, and performance.



Overcoming Barriers to Automation

Industrial and manufacturing companies have long welcomed automation, particularly where there are workforce shortages, skills gaps, safety considerations, and directives to “do more with less.”

Fixed robots, early mobile robots, and drones provided options to automate certain manual tasks, and industrial internet of things (IIoT) sensors emerged to help automate data capture for advanced analytics.

However, each of these solutions has its limitations.

Fixed and Early Mobile Robots

Fixed robots are restricted in terms of functional capabilities. Wheeled or tracked robots have mobility challenges in tight environments and areas with stairs, uneven terrain, or mud.

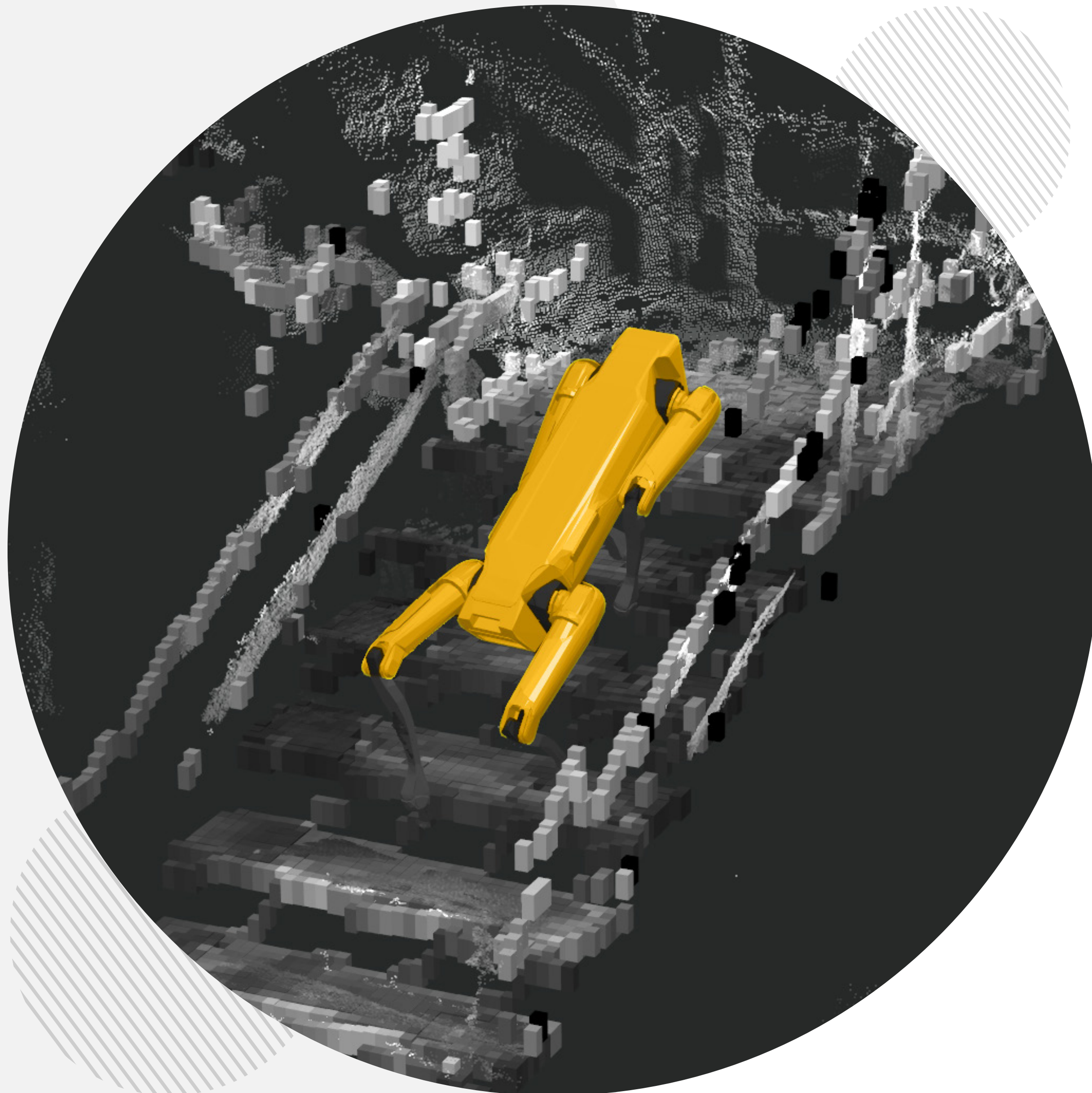
Drones

Untethered drones have battery life constraints. Tethered drones fly longer but their range and maneuverability are constrained by the tether. Drones flying beyond the visual line of sight (BVLOS) require a special FAA waiver.

IIoT Sensors

As for IIoT sensors, purchasing and implementing them in great numbers throughout an enterprise is cost-prohibitive, and the battery-powered models require routine inspections and maintenance.





Because of these challenges, many organizations continue to rely on manual inspections and data collection despite it being error prone, expensive, slow, and impractical in remote or hazardous environments.

Consequently, many are still struggling with core business metrics, including:

Safety

The imperative to remove workers from hazardous situations, prevent injuries, and reduce claims

Reliability

The necessity to predict and schedule maintenance based on consistent, current, and accurate operations data to optimize asset availability and longevity

Efficiency

The need to engage workers with higher value work while reducing labor costs

Performance

The requirement to minimize planned and unplanned downtime, which can cost in the hundreds of thousands, if not millions of dollars a day

A holistic solution linking data capture, visualization, and analytics can improve the reliability and availability of physical assets. It requires repeatable, timely, reliable, cost effective, and scalable data capture, even in remote and hard-to-access areas, to increase the effectiveness of existing asset and enterprise performance management (APM/EPM) solutions. It also must eliminate the blind spots concealing safety and downtime risks by consolidating real-time, decision-support data.

Why Spot Could Be Your New Best Friend

Through remarkable advancements in robotics, the engineers behind Spot have built an easy-to-deploy solution for a variety of inspection and data gathering tasks while navigating industrial environments with dog-like mobility.

It can be trained to perform repeatable autonomous missions or controlled from afar by an operator using a web interface or tablet application and watching what Spot sees through its built-in stereo cameras.

Since Spot can go where people go and where wheeled robots and drones cannot, no site adaptation is required. It can climb and descend steep grades and stairs, step over rocks and curbs, keep steady on loose gravel and wet grass, circumvent obstacles in real time with 360° perception, and right itself if it falls.

Soon, an arm will be available that allows Spot to manipulate objects and open doors and cabinets.





Real-World Use Cases Reflect Industry Appeal

The following use cases illustrate the power of overcoming operational challenges by augmenting workforces with a fleet of robots running inspections and collecting data on demand.

Nuclear Plant Inspections for a Major Utility

Safety is the number-one priority in nuclear power generation. A leading nuclear power provider is one of the early adopters assessing Spot for critical safety applications. Its first focus was preventing unnecessary reactor shutdowns, as each one costs the utility \$1.5 million.

Before being deployed to the operations team, the quadruped was tested in the nuclear plant's reactor area to verify its mobility was fit for the purpose and that it could capture detailed inspection photos. The successful trial provided the plant with "ground-truth" validation of the indirectly obtained data in its plant management systems.

The plant is now assessing Spot's value for automating operator rounds and readings to allow site operators with busy shifts to concentrate on higher value tasks. Mobility and sensing capabilities around the power generation site have already been verified and now autonomous data collection tests are underway.

In conjunction with computer vision experts, the plant is working to process detailed inspection photos collected by Spot into gauge readings, leak detections, and other conditions that are typically inspected manually.

Gas plant inspections at Woodside

Australia's largest natural gas producer, Woodside, is testing Spot's potential to automate routine inspection and sensing at its processing facilities. Six potential applications for Spot were identified early on: gauge reading, leak detection, noise anomaly detection, thermal inspection, gas detection, and remote inspection -- each of which could help to improve the safety, reliability, and efficiency of the facility.

The company's complex, potentially hazardous gas plant is spread out over a couple of kilometers. Covering it with sensors was determined to be cost-prohibitive, and wheeled robots were deemed too slow and impractical for the uneven terrain and stairs.

Initial use cases involved freeing up employees from rote, mundane chores, such as following the same path through the plant twice a day to assess current conditions for the next shift. This would give them more time to perform skilled work and value-added tasks instead. Spot could help read and report on analog gauges, look for water and steam leaks, inspect fittings and connectors between pipes, and listen for odd noises. It could also carry thermal cameras to detect hot spots, gas detectors to identify hazardous gas leaks, and manually inspect equipment when alarms go off.

Spot is also considered a candidate for higher-risk and more complex use cases, such as performing inspections in areas with high-voltage transformers, inspecting sites during periodic shutdowns, and serving as a "first responder" during emergency situations by collecting visual information for human response teams. It can also verify that systems such as valves or electrical equipment are isolated before a worker makes repairs.





A Distinctive Workforce with Business Benefits

Where many automation solutions have failed to live up to their potential, Spot is providing rapid time to value for the innovative firms that have embraced it.

Robotic inspection and autonomous data collection is not a technology of the future - it's easily deployable by operations managers today with minimal training. Spot is helping industrial, utility, and facility operations to elevate safety, reliability, efficiency, and performance while building skills of a distinctive workforce for the digital age.

About Boston Dynamics

Boston Dynamics is a world leader in mobile robots, tackling some of the toughest robotics challenges. We combine the principles of dynamic control and balance with sophisticated mechanical designs, cutting-edge electronics and next-generation software for high-performance robots equipped with perception, navigation and intelligence. Boston Dynamics has an extraordinary and fast-growing technical team of engineers and scientists who seamlessly combine advanced analytical thinking with bold engineering and boots-in-the-mud practicality.

Read case studies and see Spot in action at www.bostondynamics.com/spot



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