TVA : AI and Robotics Demo

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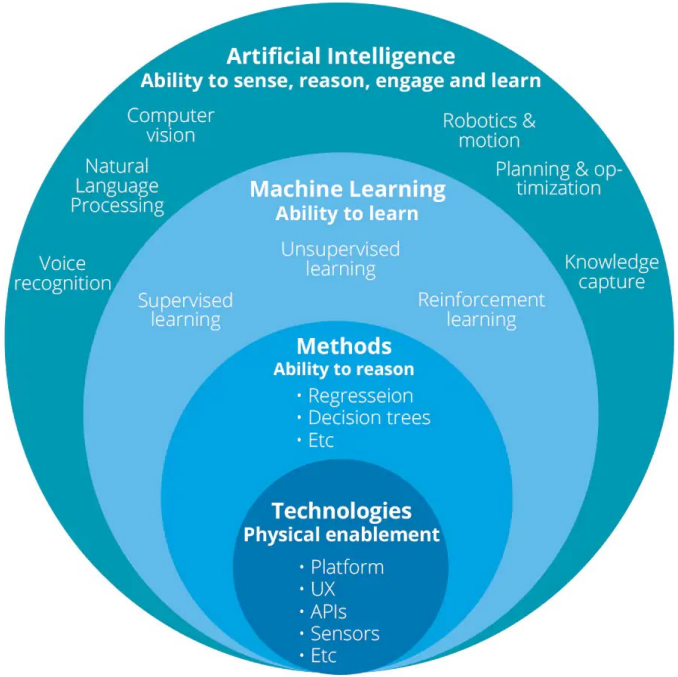
Agenda

- Overview of TVA's Enterprise Analytics
- AI and Computer Vision Overview
- Introduction to Spot the Robot
- Spot Demonstration
- Use case applications with AI/Robotics
- Close – Q&A

Artificial Intelligence Defined

The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.



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Computer Vision

Computer Vision is an interdisciplinary scientific field that deals with how computers can be made to gain high-level understanding from digital images or videos.

From the perspective of engineering, it seeks to automate tasks that the human visual system can do.

Input

Computer Vision

```
Min angle (lowest possible angle of dial) - in degrees: 45
Max angle (highest possible angle) - in degrees: 315
Min value: 0
Max value: 200
Enter units: psi
Current reading: 16.3660965493 psi
```

Results

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Object Detection Process

1. Gather many images of objects we want to “view”
2. Label target objects
3. Train an object detection model using TensorFlow (or other deep learning framework)
4. Use the model on any new images that we want to apply computer vision to

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Using Sensors and Robots to Capture Data

Vibration

Temperature, humidity

Pressure, force

Video, Still image,
Thermal, Lidar cameras

Acoustics

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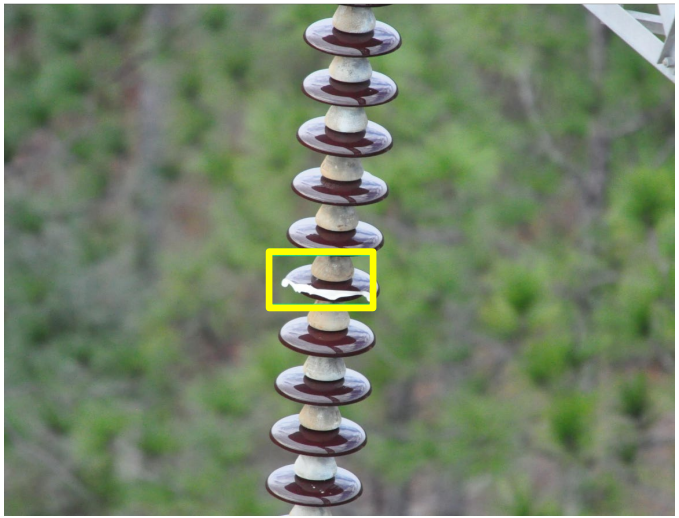
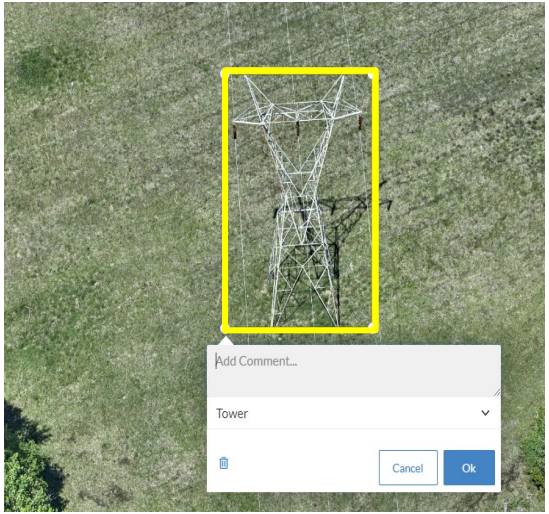
Drone and Image Analytics

- Drones capture images of hard-to-reach transmission, generation assets
- Use algorithms for surveying and inspection
- Use algorithms to detect damaged equipment





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Spot the Robot

- High degree of autonomy, navigates challenging terrain, avoids obstacles
- Sensors – camera (thermal, optical, lidar, acoustic)
- Integrates with AWS services, and Microsoft Azure, or create custom integrations through Spot's extensive API

Spot Demo

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Spot the Robot : TVA Use-Case

- TVA has hazardous areas where humans either cannot access or need extreme caution
- TVA performs many single-person checks and tasks around various facilities
- Spot's advanced agility, programmability, and ability to convert analog data to digital can vastly improve TVA's safety while lowering costs of basic repetitive tasks

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Component Tag Detection and Reading with Spot

- Every component inside a nuclear plant has a tag for identification
- There are 10,000+ tags throughout a Radiologically Controlled Area
- Currently, maps of component locations are minimal to none
- Object Detection Models can detect tags in an image
- Optical Character Recognition (OCR) models can be used to read tags from a given image

Estimated 8,500+ hours annual process efficiency savings

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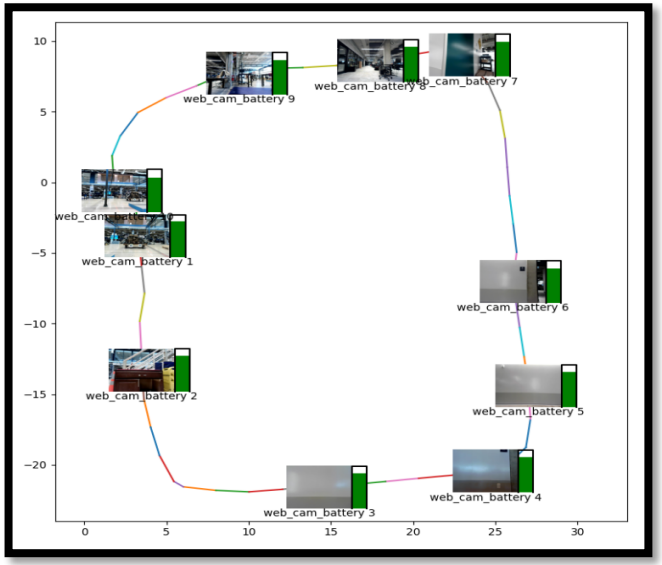
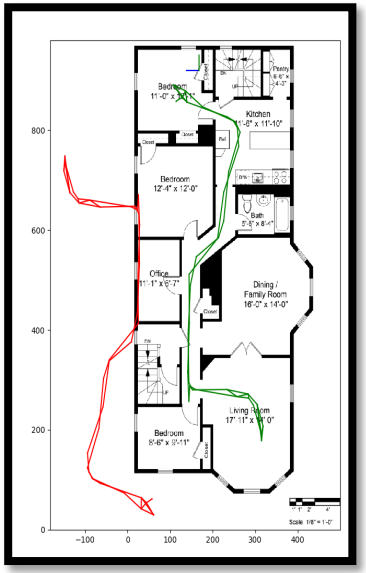
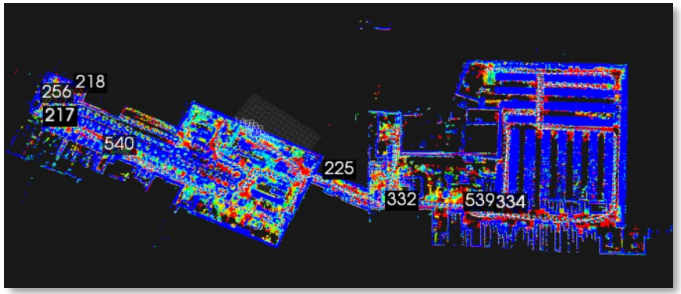
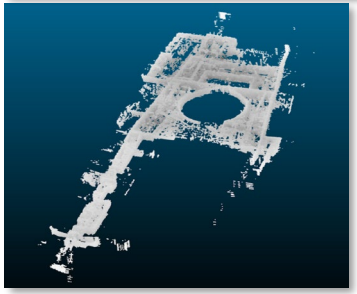
Component Tag Mapping with Spot GraphNav

- Spot “missions” allow for X, Y mapping of Spot’s location and actions using GraphNav.
- These graphs can be overlayed on blueprints or any other to-scale drawing.
- Once recorded, these graphs allow Spot to replay missions and gather new data points.
- Goal is to create an application with searchable maps containing all data Spot gathers on missions.



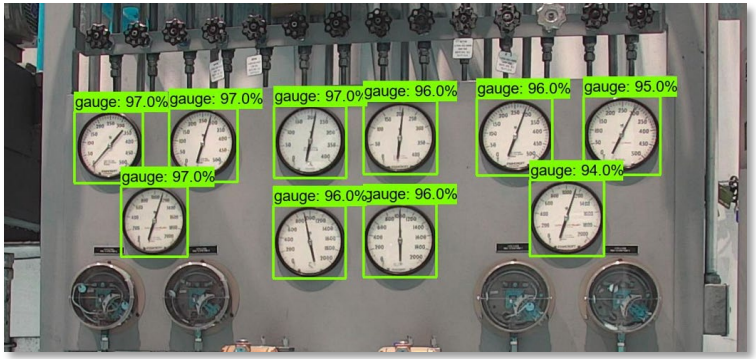






Analog Gauge Detection and Reading

- Analog gauges are still widely used and require visual inspection to obtain readings
- Costs operators time, introduces human error, and can put operators in potentially hazardous areas
- Neural Network models can be trained to detect individual gauges and output values using transfer learning



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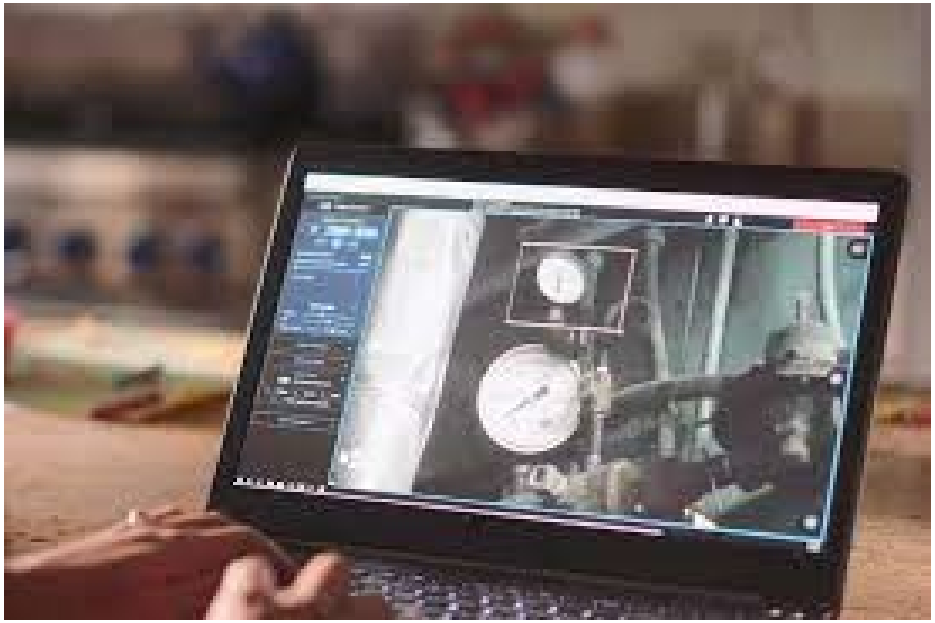
Remote Access with Scout



- Scout application allows for remote site access and inspections of visual, thermal, audio, or any other form of data
- Missions can be scheduled to ensure consistent data history
- Analytics can be run 24/7 and review the data at any time

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Value From AI/Robotics

The goal of robots and drone in the power industry is attaining autonomy to perform the inspection of risky, time consuming, and hard to reach assets, as well as to help in the maintenance and operations of those assets.

Improve Safety

- Remove personnel from dangerous, electrified, radioactive, explosive environments
- Collect data remotely and identify risks from afar

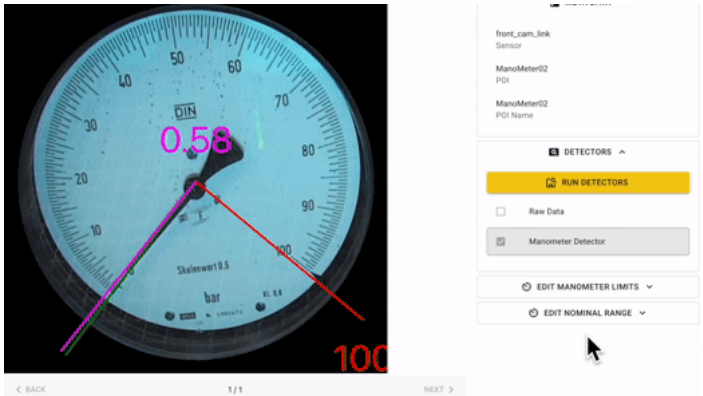
Improve Efficiency

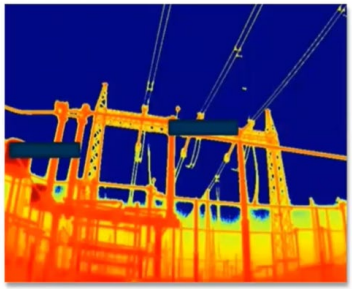
- Reduce cost and time to inspection
- Improve uptime
- Redistribute time to critical decision making

Improve Predictability

- 100X data collection
- Reduce fixed sensors
- Visual inspections
- Thermal anomalies
- Acoustic anomalies

Many Potential AI/Robotics Use Cases





- Gauge reading and anomaly detection
- Corrosion detection
- Equipment anomaly/health detection
- Electrical Arc Detection
- Inspect oil levels in transformers
- Inspect transformer leaks
- Generate thermographic reports on the health of the different PV solar plant components
- Thermal imagery to detect defects in pipes
- Gas leak detection (SF6, H2S, Methane, etc.)
- Vibration Anomaly Detection
- Radiation mapping and anomaly detection
- Digital Twin Creation
- 3D scanning of construction sites
- Digitize facilities – LiDAR
- Inventory Management
- Vegetation Management
- Nuclear tank inspection

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