Automating distribution inspection with AI

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About the Need/Opportunity

- Threats from extreme weather threaten the reliability, resiliency and safety of the electric grid
- Proactive asset inspection and inventory can help mitigate these risks, but nascent, innovative methods have not been widely adopted on distribution
- Current methods of distribution asset inspection and inventory require dedicated vehicles and crews (a.k.a. grid patrols)
- Grid patrols in their current form
  - Inefficiently allocate resources (when patrolling, crews can’t do other tasks)
  - Are costly / increases O&M
  - Are difficult to scale for risk mitigation, especially considering increased threats from extreme weather events
About the Technology

Noteworthy’s computer vision technology mounts onto existing fleet vehicles to identify components & equipment defects whenever any fleet vehicle is in motion – without having to mobilize dedicated inspection teams.

SOLUTION COMPONENTS

• Inspector Edge – vehicle-mounted cameras, compute & AI
• Inspector Cloud – facilitates review of findings

FEATURES

• Component detection – transformers, insulators, cutouts, lightning arresters, crossarms, etc.
• Defect detection – corroded transformers, broken lightning arresters, damaged crossarms, etc.
• Geolocation – approximate pole coordinates
Project Scope

PROJECT INTENT
Demonstrate Noteworthy’s approach to distribution inventory / inspection and assess its value to FirstEnergy. Deploy across two territories: Fairlawn, OH and Salem, OH.

OBJECTIVES
✓ Install Inspector Edge on 2 utility fleet vehicles
  • Document utility SME analysis on distribution inspection and inventory requirements and Noteworthy’s perceived value
  • Collect and label vehicle mounted imagery to support artificial intelligence model training and development
  • Field Test the Inspector Edge performance on segments of distribution with known pole locations, configurations, and overhead components

SUCCESS METRICS
• Accuracy – predictions vs. ground truth
• Speed – compared to existing processes
• Cost – compared to existing processes
• Quality – of collected imagery
Project Scope

Each Inspector Edge device consists of two components: the interior unit and the exterior unit. Each unit must be installed / integrated with the fleet vehicle.

**INTERIOR UNIT (Compute)**
- Runs AI models
- Onboard GPS & cellular
- Installs in vehicle cab
- AC or DC power source (15w)

**EXTERIOR UNIT (Vision)**
- Multiple machine vision cameras
- Antennas for GPS & cellular
- Installs on roof of vehicle cab
- Cable bundle connects to interior unit
Project Scope

We installed two Inspector Edge devices on two separate Freightliner M2 bucket trucks. The vehicle installation and integration process consists of four steps.

Positioning the Exterior Unit on roof of vehicle cab. Ample clearance must exist between the bucket’s boom and the top of the unit.

Installed Exterior Unit is secured using a suction cup based mounting system. Cameras can be adjusted independently of the platform.

The Exterior Unit’s cable bundle was routed through an existing vent which was then sealed with waterproof tape.

The Interior Unit was mounted behind the passenger seat. The Exterior Unit’s cable bundle was snaked through the liner on the back wall of the cab.
Learnings to Date

Learnings thus far?

• We had assumed that most heavy-duty bucket trucks would have stainless steel roofs, not true. So we couldn’t use magnet mounts but devised an alternate solution that uses suction cups for exterior unit.

• Production deployments will need a more permanent exterior unit installation, as concerns exist about tree branches

• There are existing antennas on the vehicle’s roof that we need to work around when mounting our cameras

• Under-seat air ride suspension limits the amount of space available for interior unit

• Don’t assume consistent power will be available from the cigarette lighter ports – when the truck starts, voltage drops significantly. We’re using a UPS/battery to account for this.

Successes?

• We did ultimately install on a fleet vehicle

• We’ve begun to collect data

Barriers?

• One of the Exterior Units has a camera connectivity issue that is preventing data collection
Sample Images
Sample Findings

Corroded Transformers

Vegetation Overgrowth

Asset Identification

Missing Fuses

Split Wood
GIS: Pole Detection / Geolocation

Poles Detected: 80%
GPS Precision: 20ft
GIS: Pole Detection / Geolocation

Existing FirstEnergy GIS
Olive marker is pole
Red marker is transformer (actually on olive marker)

+ Noteworthy GIS
Yellow marker is pole
Average GPS precision ~20ft
Noteworthy AI: Captured Pole Image with Transformer
Noteworthy AI: Component Detection
Pilot Summary

Before
- Existing imagery in FirstEnergy GIS - 934 pictures.
  - No consistency, spans multiple years.

During
- Approximately 5,000 images collected
- Approximately 1,650 poles
- Pole geolocation precision within 20 ft
- All during “routine” circuit inspections (capital and O&M) at low cost to utility
  - The goal would be to reduce the need for dedicated patrols because they are being inspected more often

After: Extended Pilot - 2022 Circuit Patrols
- This would make trucks productive during drive time
- Explore defect identification, inspections cap and O&M, with Noteworthy AI with dedicated team (engineering, finance, operations, etc).
- EPRI is scoping a collaborative terrestrial scanning project.
Coming Soon

Ground-based Imagery
Our Team

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