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Insulator Orientation Detection

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Global

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Asia Pacific and Japan
2 YEARS IN A ROW

databricks
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Asia Pacific and Japan

Partnerships

Microsoft Solutions Partner

databricks Elite Partner

SAP Silver Partner

Red Hat Ready Business Partner

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- Analytics
- Infra and Database Migration
- Kubernetes
- Cloud Security
- Low Code No Code
- Intelligent Automation

INDIA | USA | CANADA | APJ | MIDDLE EAST | AUS

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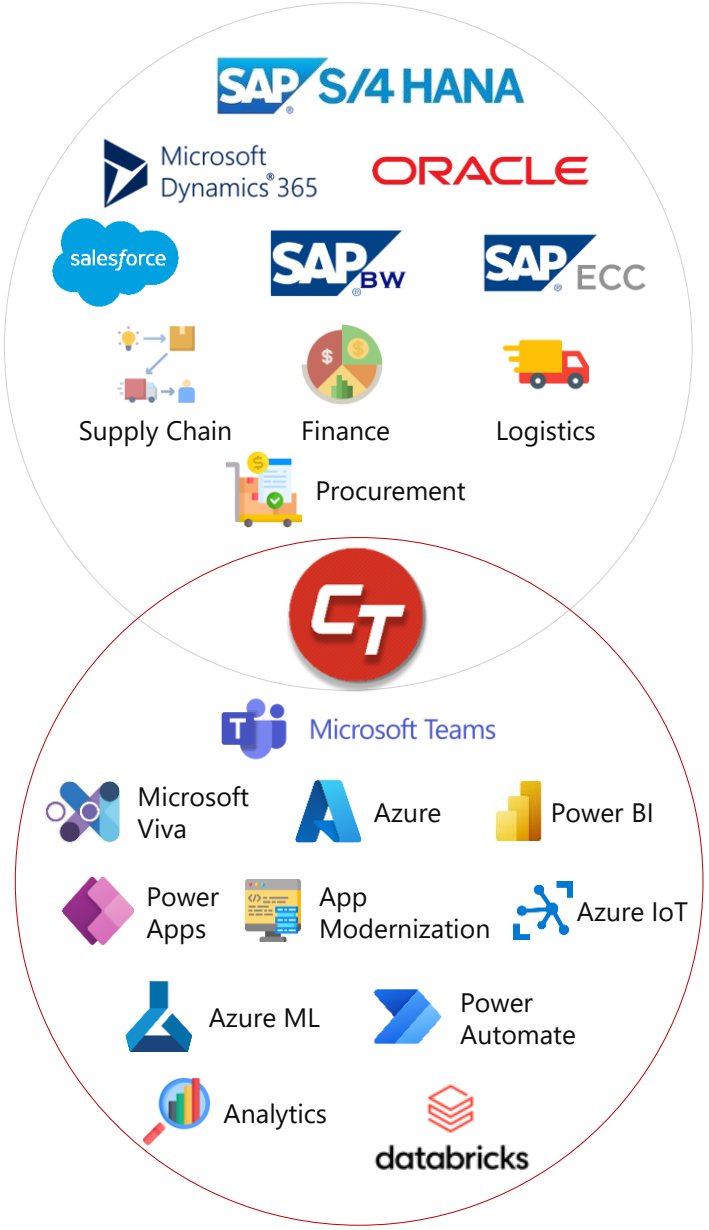
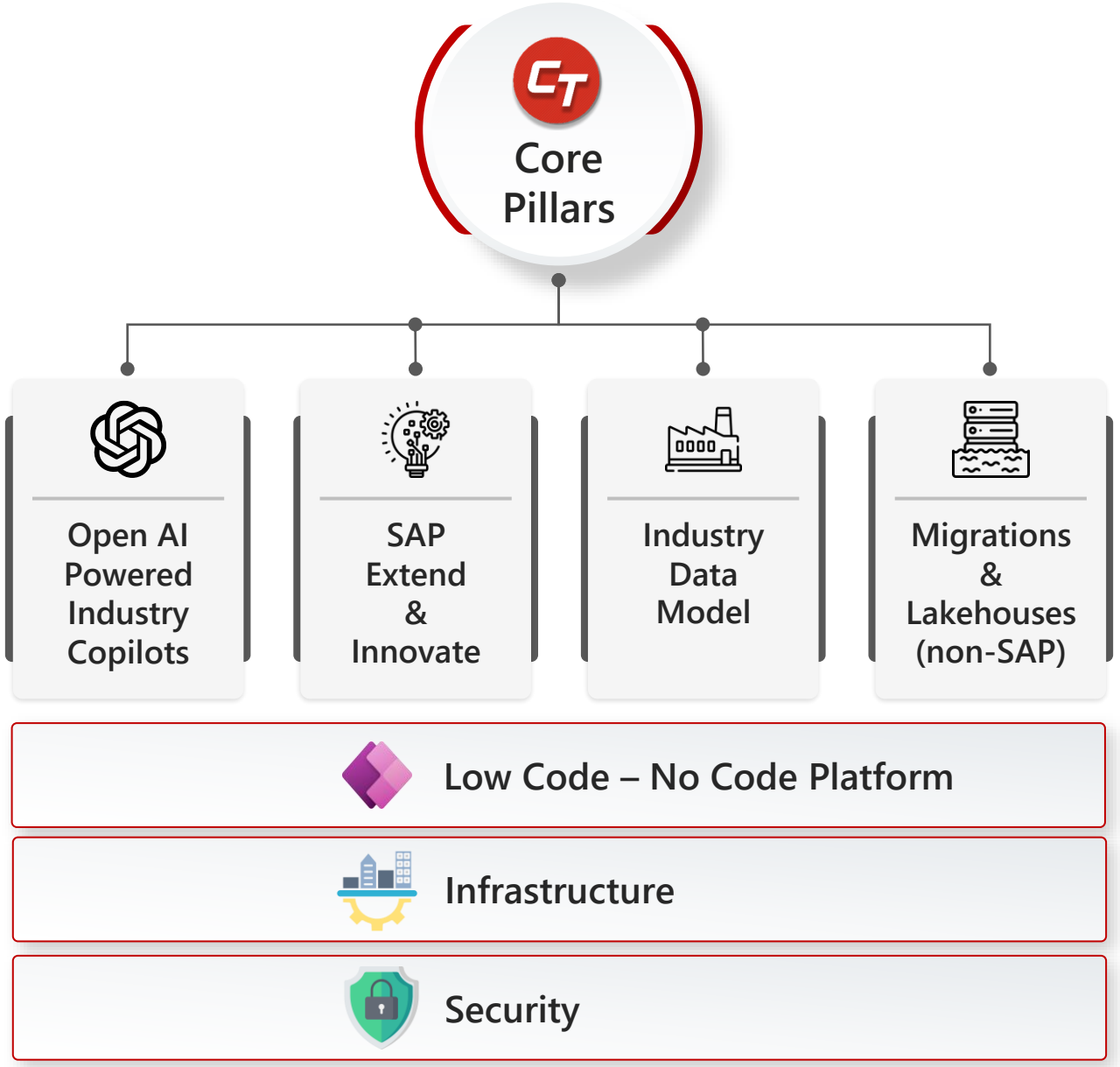
500+ AI Certifications

Industries We Serve

- Manufacturing
- Retail & CPG
- Financial Services
- Energy & Sustainability
- Healthcare & Life Sciences
- Media & Entertainment

Celebal Core Pillars





Insulator Orientation Shell Detection

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1. Brief Description of the Solution:

Our Insulator Orientation Detection Solution enhances accuracy and efficiency in energy infrastructure maintenance by identifying faults or misalignments in insulators across substations, transmission lines, and renewable assets. It prevents failures that can disrupt power reliability and grid stability. Built on Azure Machine Learning, Azure Kubernetes Service, Azure Container Registry, Azure Cosmos DB, and Azure Blob Storage, it offers automated detection, real-time monitoring, and actionable alerts. Leveraging Azure Custom Vision, SAM (Segment Anything Model) for pixel-level precision, OpenAI CLIP for contextual analysis, and few-shot learning, it quickly adapts to new or damaged insulators with minimal data.

2. Business Problem It Solves:

Energy infrastructure operators face significant challenges in maintaining the integrity, safety, and operational efficiency of their assets. Traditional methods of inspection and monitoring are often labor-intensive, reactive, and prone to human error. These limitations can lead to safety incidents, service disruptions, regulatory non-compliance, and increased maintenance costs. The solution addresses these challenges by automating detection processes, providing continuous monitoring, and delivering timely alerts and insights for proactive maintenance and risk mitigation.

3. Value Add for Customer:

- Accurate Insulator Detection: Utilize advanced AI algorithms and custom vision to accurately determine insulator orientation across your electrical infrastructure.
- Real-time Monitoring: Enables around-the-clock surveillance of insulator positions, allowing timely action on any deviations from standard alignment.
- Intelligent Data Insights: Provides actionable analytics to identify patterns, anticipate faults, and support data-driven maintenance planning for improved grid performance.
- Integration with Existing Infrastructure: Seamlessly integrates with existing electrical systems, enhancing their capabilities without the need for extensive modifications.
- Automated Alert System: Automatically trigger notifications to operators and maintenance teams when misaligned insulators are detected, enabling faster issue resolution.

Few shot Image Segmentation (SAM + CLIP)

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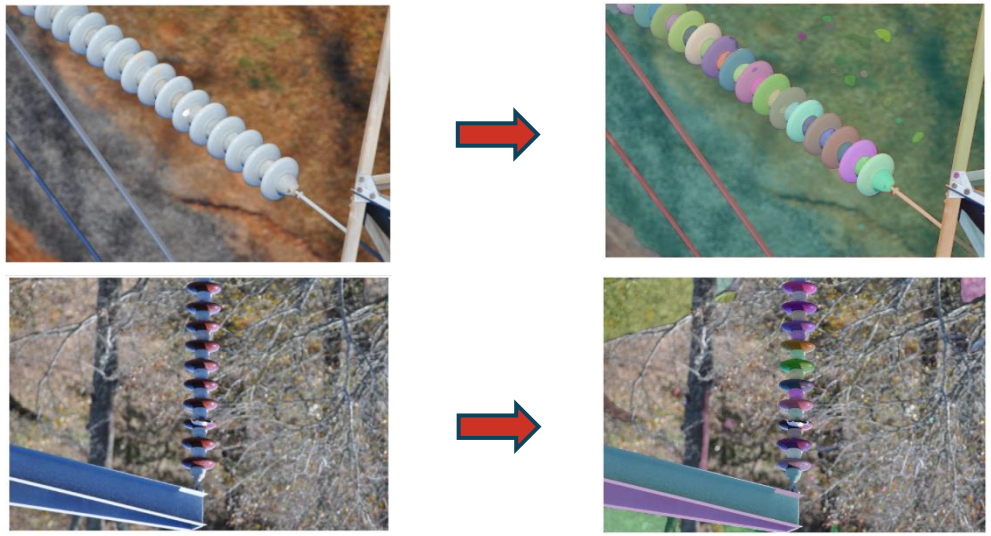
Overview

This approach uses zero-shot learning with FAIR's SAM model for image segmentation with minimal labeled data. CLIP model is used to filter segmented regions based on natural language prompts, enabling rapid development of image segmentation applications with little to no training data.

Object proposals generated by SAM (Zero Shot)



Approach

Get all object proposals generated by SAM

↓

Crop the object regions by bounding boxes

↓

Get cropped images' features and a query feature from CLIP

↓

Infer mask regions based on similarity between image features and the query feature

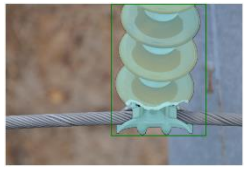
Results

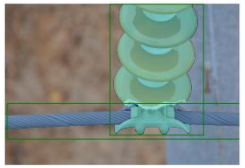
Inputs
Image + prompts

['an insulator']'

['a insulator', 'a metal wire']

Preds
Segmented images





Conclusion

Hence by cropping object regions and extracting visual features with CLIP, we can efficiently perform instance segmentation selectively using natural language prompts by matching images and textual contexts. This approach has a significant impact on applications such as image retrieval and segmentation of various region of interests, where accurate and efficient collection of data is critical for user experience and productivity.

Tower Top Insulator Detection via Aerial Images - Approach

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Overview

We present the process of using OpenAI's CLIP (Contrastive Language-Image Pre-Training) model for object detection on a dataset of images of insulators on electrical poles. By using few-shot Training on this dataset, we can enable it to identify and locate insulators in images, enabling efficient monitoring of power systems.

Prompt Engineering

We crafted natural language prompts that can elicit specific responses from the model, such as "Identify the insulator in this image." We also added additional noise to the text.

For Example:

Insulators on transmission towers are designed to prevent electrical currents from leaking to the ground, which can be a safety hazard.

Few Shot Training:

The Few Shot training process involves training the model to identify and localize insulators in the images using very few samples. We provided some annotated samples of the target feature along with Noisy Prompts explaining the same.

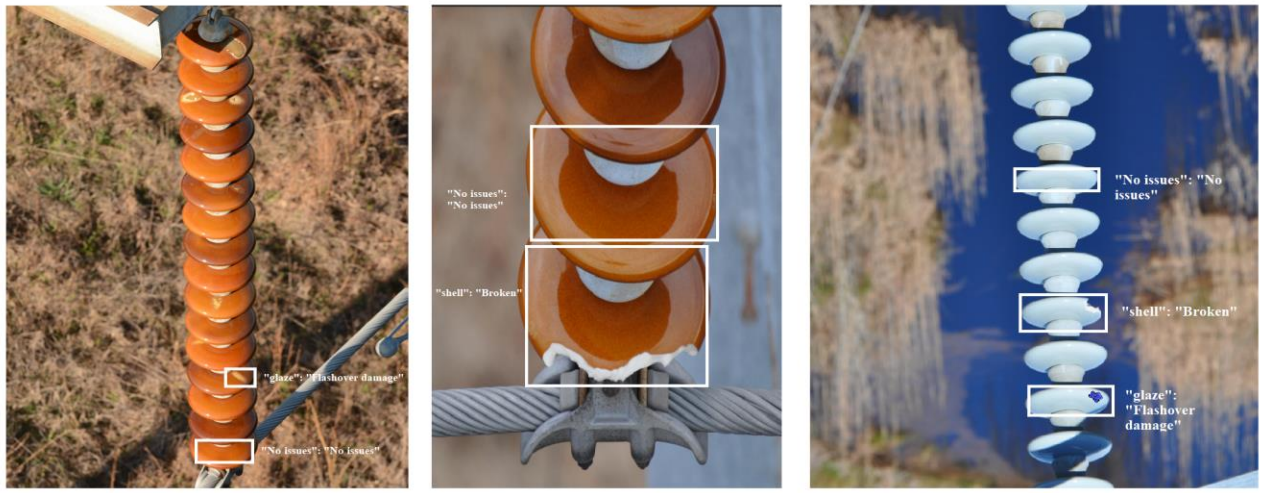
Approach

Data Collection → Prompt Engineering and Annotation of Image → Few Shot Training → Inference

Data Collection

We collected a dataset of high-quality images of insulators on electrical poles from various sources, including public databases and images captured by field technicians. We ensured that the images are of high quality, with clear visibility of the insulators, and captured from different angles and distances.

Insulator Defect Sample Data

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Thank You