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Broken Insulator Shell Detection

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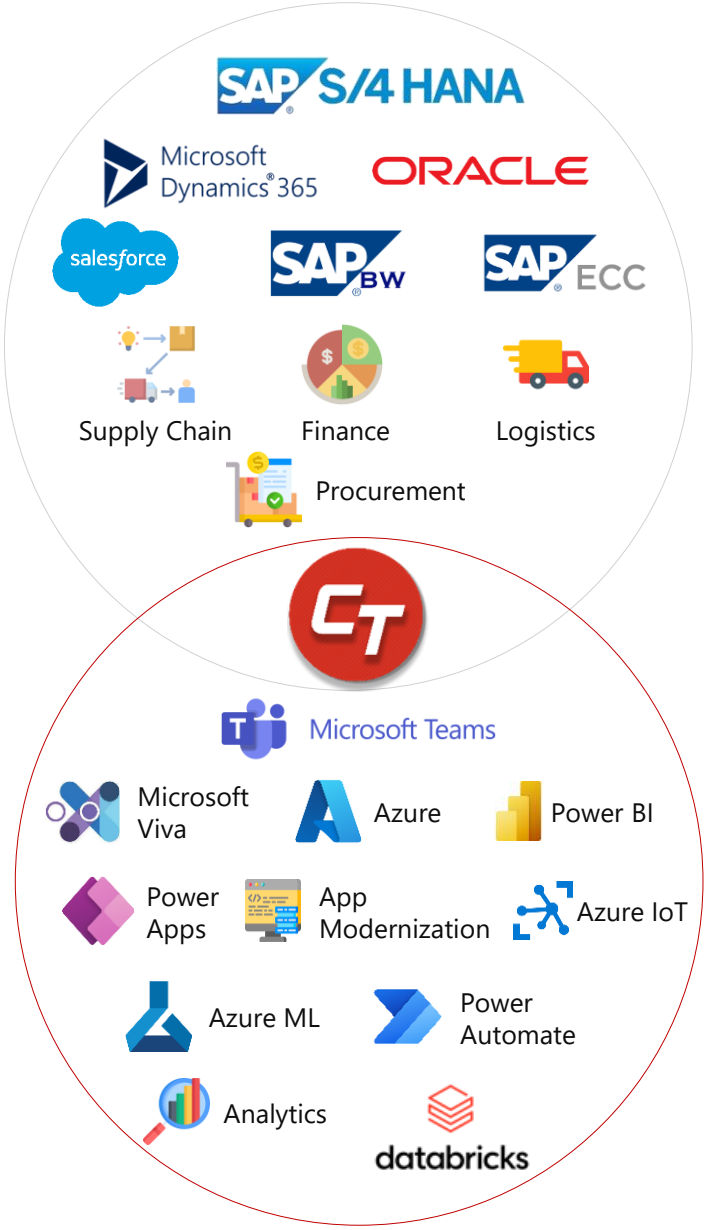
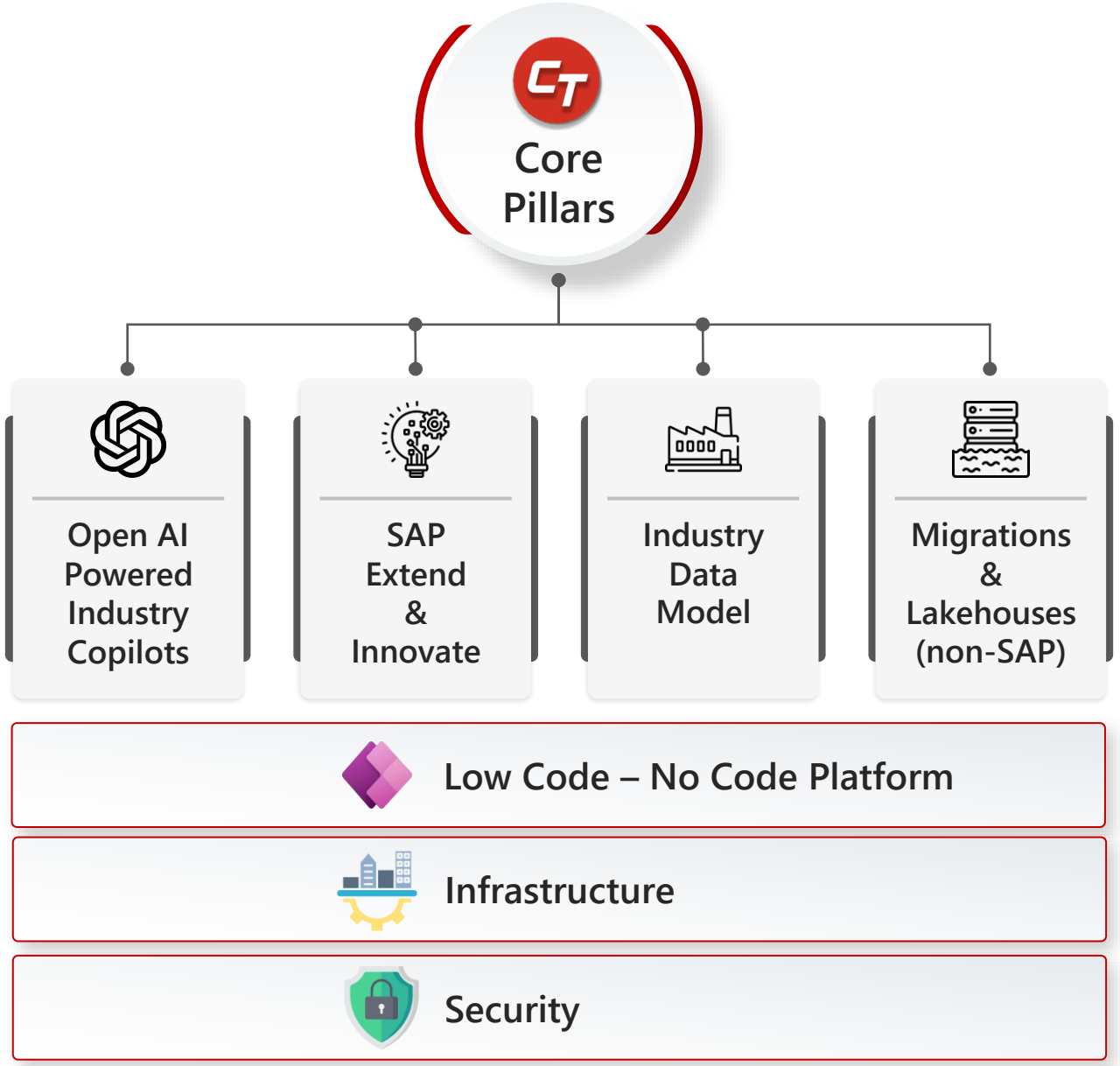
Celebal Core Pillars





Broken Insulator Shell Detection

1. Brief Description of the Solution:

The Broken Insulator Shell Detection solution accurately identifies cracks, corrosion, and surface defects with minimal manual effort. Built on Microsoft Azure technologies, Machine Learning, Kubernetes, Container Registry, Cosmos DB, and Blob Storage, it enables continuous visual analysis for early fault detection. Using Azure Custom Vision, Segment Anything Model (SAM), and OpenAI's CLIP (Contrastive Language-Image Pre-training), it supports few-shot learning to adapt quickly to new insulator types. This solution helps energy enterprises reduce downtime, improve safety, and maintain grid reliability.

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:

- **AI-Powered Detection:** Trained on vast image datasets for accurate damage identification.
- **Instant Alerts:** Real-time notifications for quick response to detected issues.
- **Live Monitoring:** Continuously tracks insulator health for immediate damage detection.
- **Predictive Insights:** Anticipates failures using historical trends for proactive maintenance.
- **Actionable Reports:** Delivers clear, data-driven insights for better decisions.
- **Easy Integration:** Fits smoothly into existing systems to boost safety and efficiency.

Few shot Image Segmentation (SAM + CLIP)

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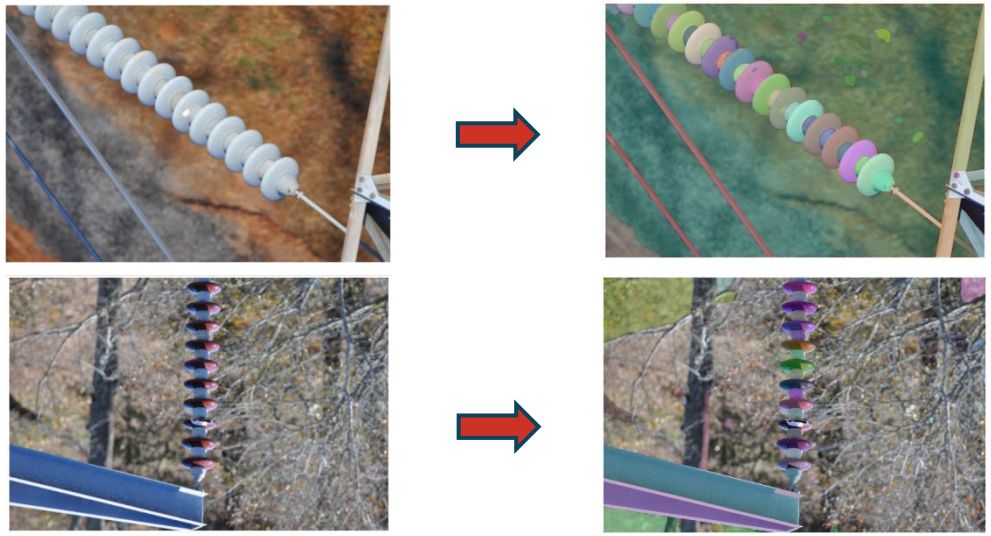
Overview

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

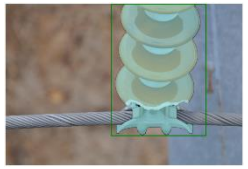
Results

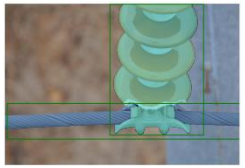
Inputs
Image + prompts

['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.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Thank You