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Session : DEEP DIVE SESSION ON AI, ML AND ROBOTICS USE CASES FOR UTILITIES

NOVEL METHOD FOR ALARMING SYSTEM BASED ON OPTICAL CHARACTER RECOGNITION AND MACHINE LEARNING

Presented By

VSKS KUMAR PABBINEEDI, MANAGER , POWERGRID

INTRODUCTION

Leveraging OCR, OpenCV, and Local LLMs for Fault Detection and Proactive Maintenance in HVDC Converter Stations

- In power systems, data drives decision-making, fault analysis, and maintenance.
- Utilities rely on data to monitor, control, and optimize complex systems like power-grids including FACTS.

CONTEXT

- One of our HVDC station commissioned in 2005 lacks an operator intuitive interface, audible alarms and dedicated historical data processing.
- For an instance, the absence of an audible alarm in the existing HMI poses a significant operational risk. Visual alerts alone may not capture the operator's attention during high-stress scenarios, leading to delayed responses.
- Replacing legacy systems is often prohibitively expensive and are also limited by complexity of technology , OEM support and Obsoleteness.
- To address the above difficulties, a Raspberry Pi 4-based system was developed, utilizing a camera module, OpenCV for image processing, OCR for text extraction, and AI-based keyword detection. Upon identifying fault-related keywords, the system triggers an audible alarm .
- This solution enhanced the observability of critical events and improved the overall reliability of the HVDC converter station. The presentation also explores the integration of AI for training the fault detection system to improve accuracy and adaptability.

RELEVANCE

Challenges in Power Systems:

- Complexity: FACTS devices and HVDC systems are highly complex to operate and maintain.
- Legacy Limitations: Legacy systems cannot handle modern requirements for real-time monitoring and predictive maintenance.

Need for Advanced Tools:

- Integration of ML, and LLMs to enhance system observability and reliability.
- Modernizing legacy systems without costly replacements.

Relevance:

- Our project Demonstrated how AI, ML, and LLMs can bridge the gap between legacy systems and modern requirements.
- Provides a cost-effective, scalable solution for fault detection, predictive maintenance, and operational efficiency.

AI Integration for Enhanced Fault Detection

Data Collection

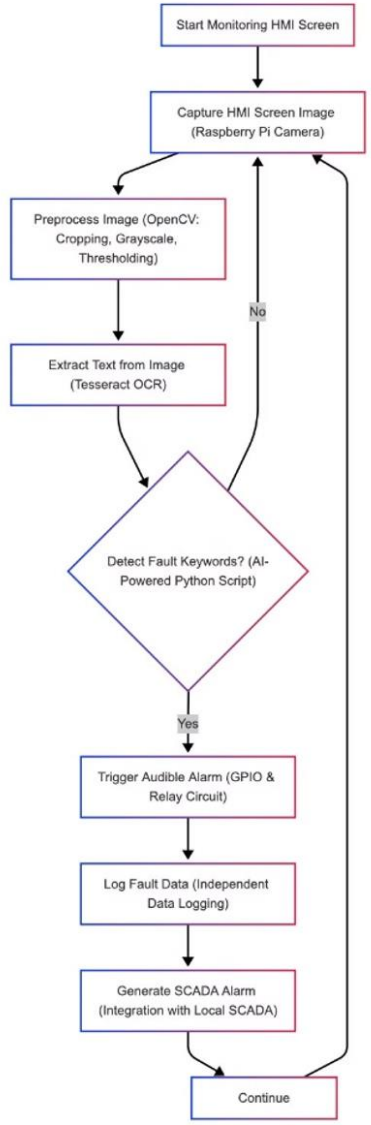
Create a dataset of HMI screen images, including both normal and fault conditions.

Model Training

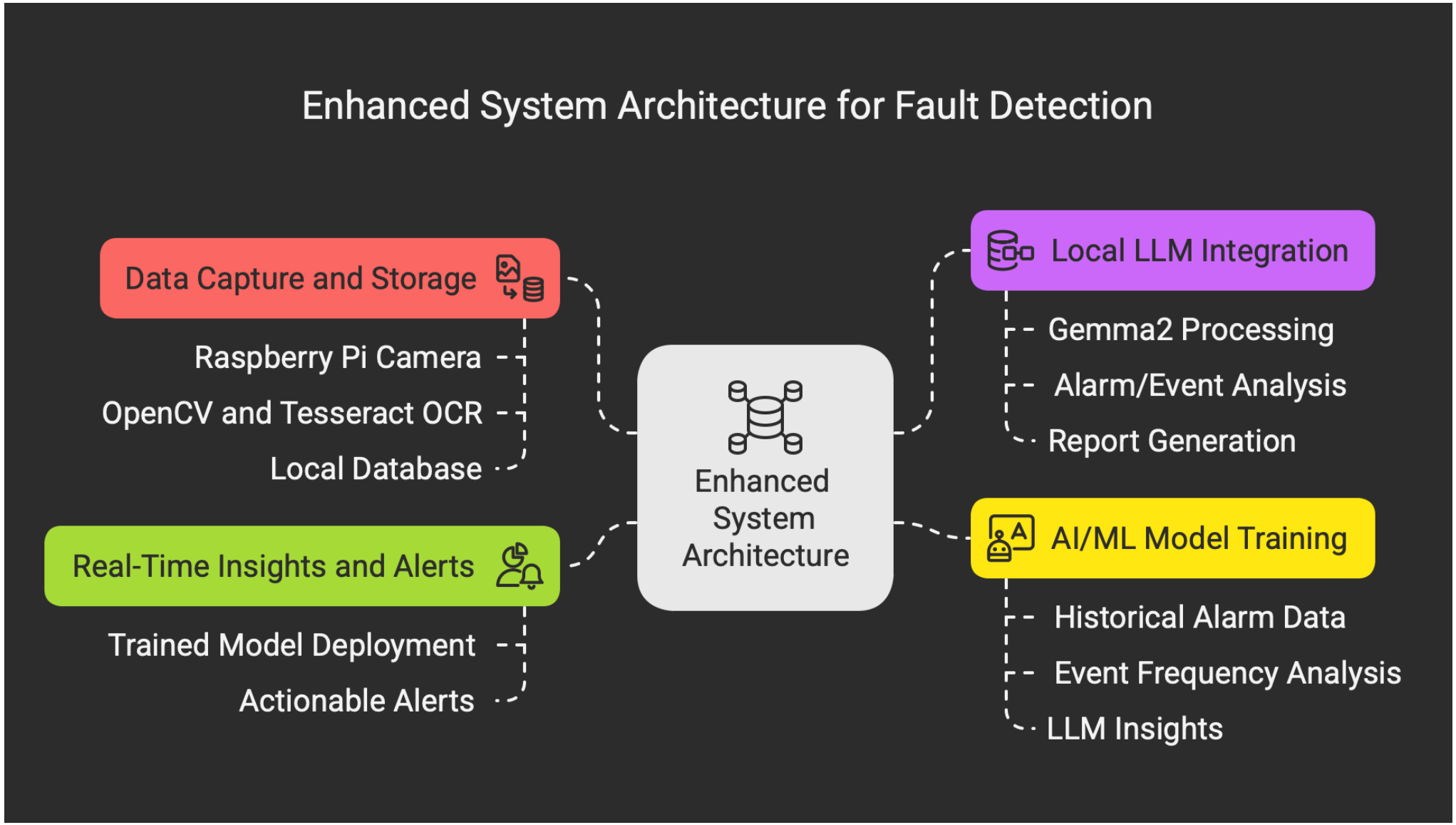
Train a machine learning model to identify fault-related keywords.

Integration

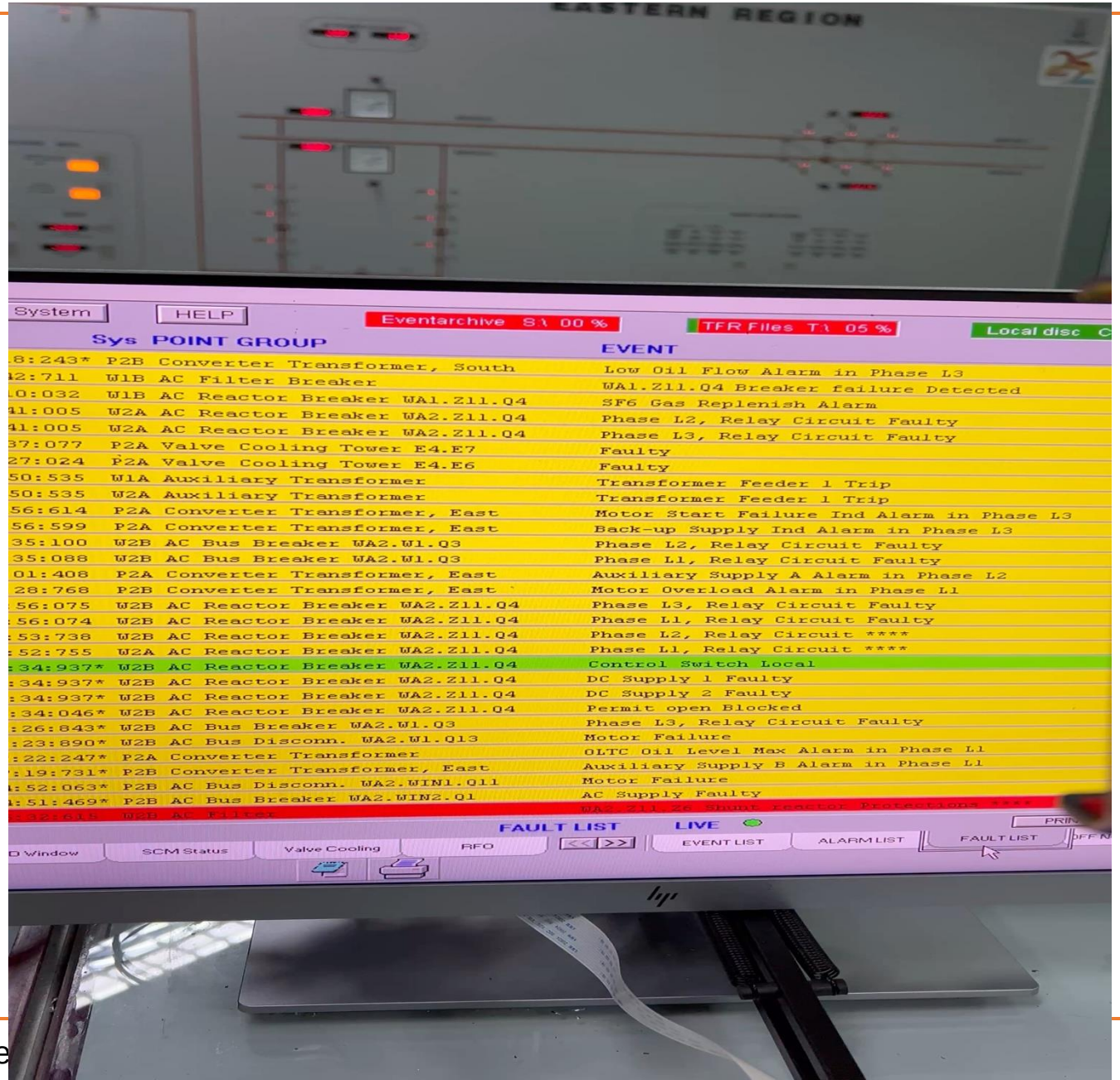
Integrate the trained model into the Python script to enhance keyword detection.



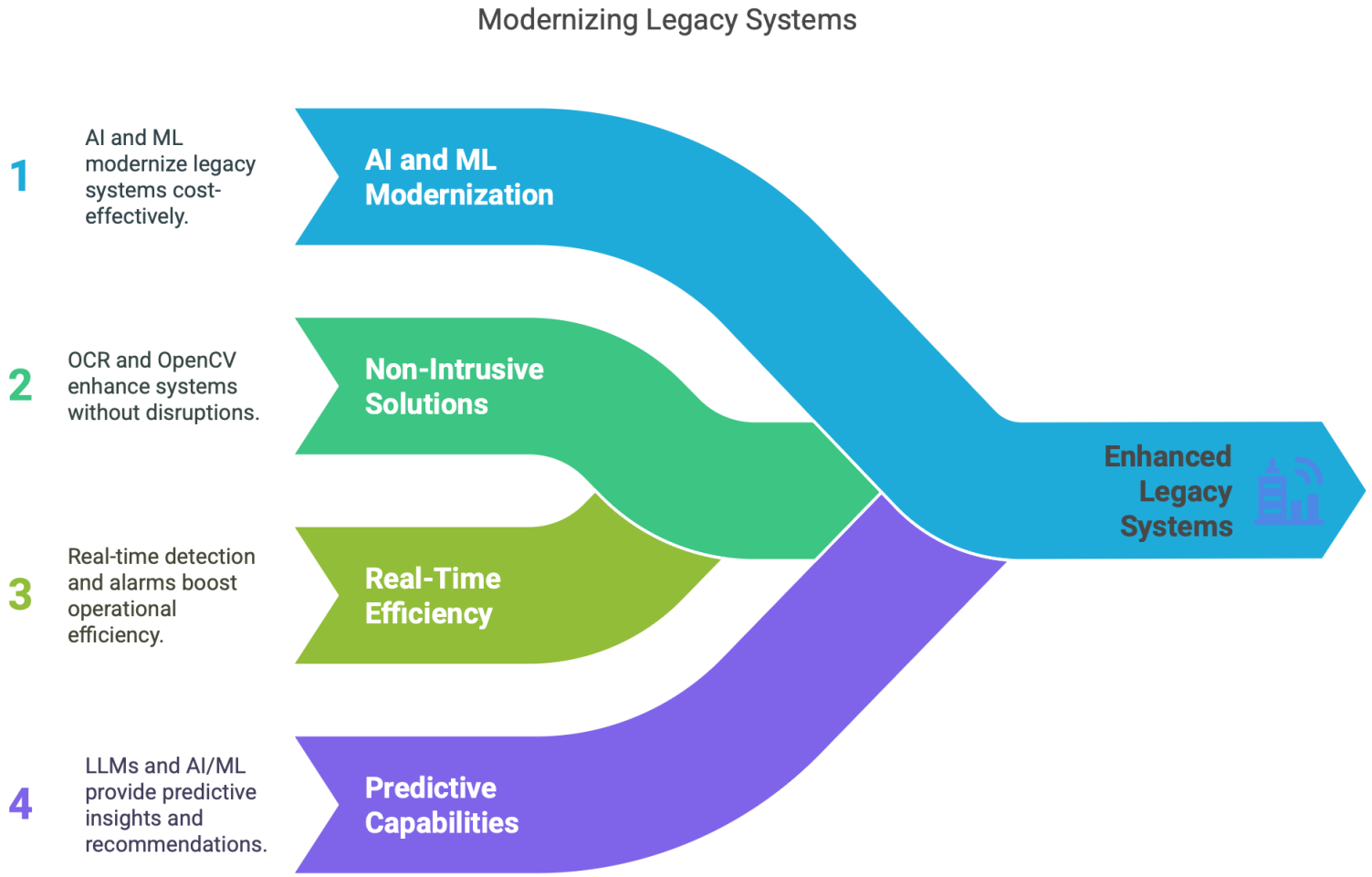
ENCHANCING USING ML AND LLMS



LIVE DEMO – VIZAG HVDC TERMINAL 2



KEY TAKEAWAYS



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THANK YOU

For discussions/suggestions/queries email:

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