MATLAB EXPO

클라우드 기반의 MATLAB 영상 검사 시스템 개발

성호현 부장, 매스웍스코리아

MathWorks®

What is Automated Visual Inspection?

Automated visual inspection is the evaluation of images or video, typically to detect failures and quality defects—often in manufacturing processes.

Automated Defect Detection

Machine Vision

Optical Inspection

Automated Inspection

MATLAB AI in a Cloud-based Visual Inspection System

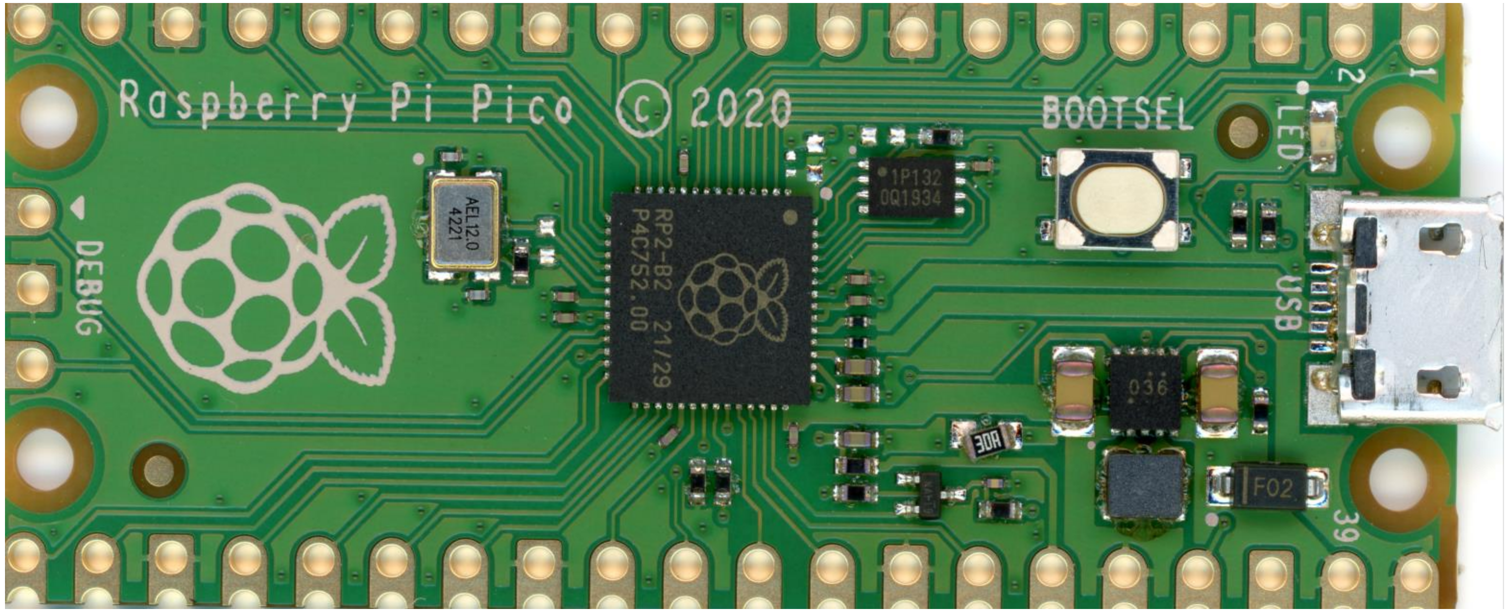
Requirements: A visual inspection system should:

- Be secure
- Run at-scale
- Be re-purposable for different applications

MATLAB’s AI solution was operationalized on the cloud using:

- Microservices built to modern standards and best practices for scalability / security
- DevOps processes for agility in development and deployment of AI and vision algorithms

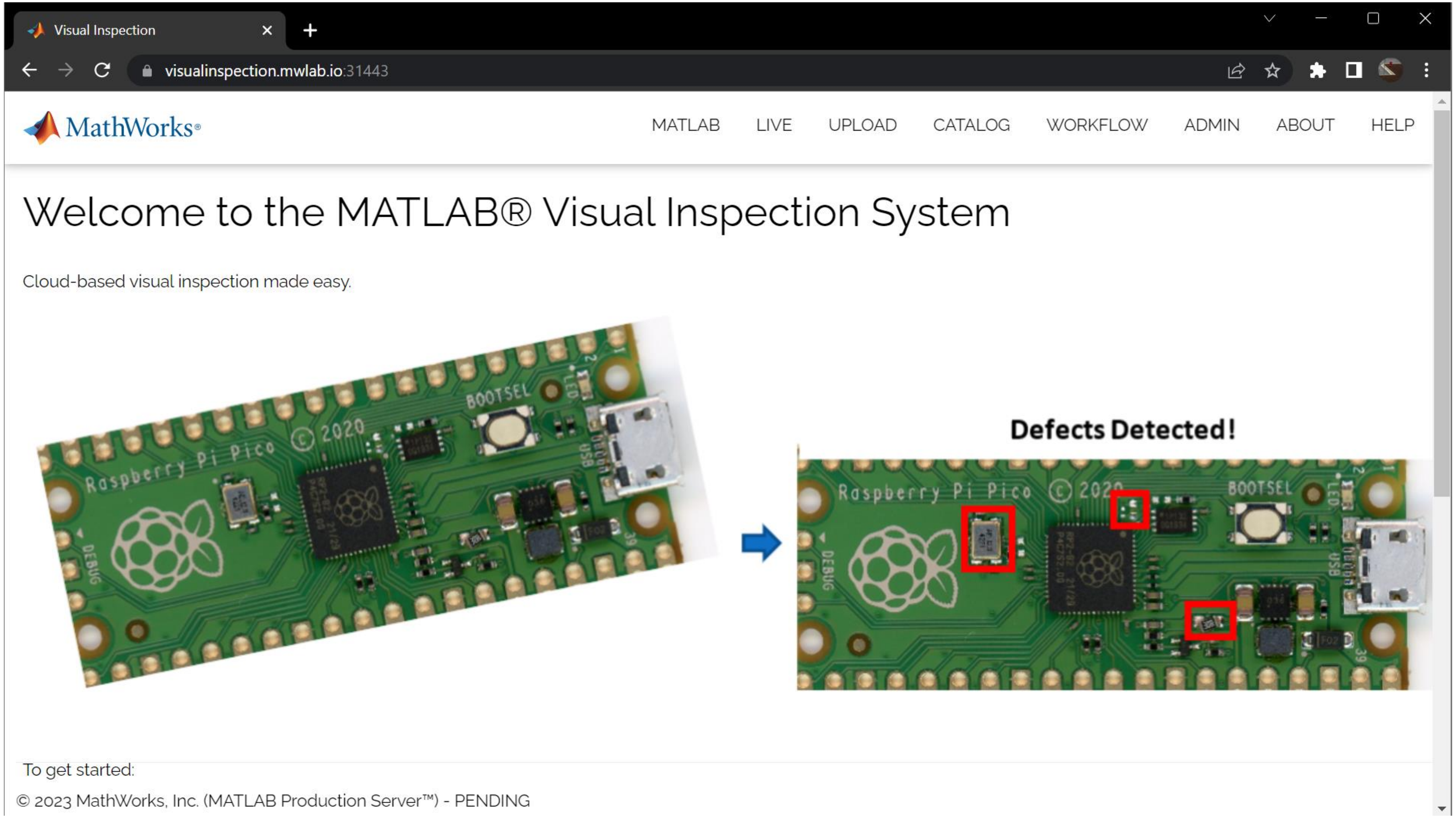
Sample Problem: Detecting and characterizing defects on a Raspberry Pi



Potential defects include:

- Misaligned components
- Bad assembly
- Damage
- Missing Solder
- Labeling mistakes
- Other?

Demonstration



A Cloud-based MATLAB Visual Inspection System

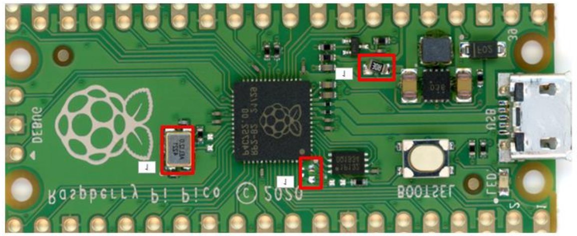
System Architecture and Overview

End Users

Access from any Mobile Device with any standards-compliant browser

Video / Stream

Images



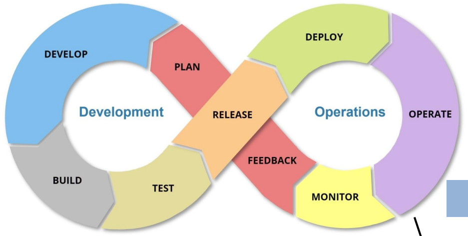
DevOps for Cloud Infrastructure

Web Application

MATLAB Production Server

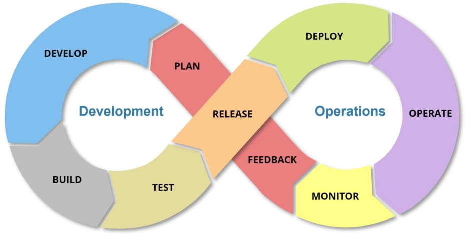
Kubernetes / Container Orchestration

Storage / Compute Infrastructure



MATLAB Developers

DevOps for MATLAB Vision / AI



IT Administrators

MATLAB Algorithm Development

Image Processing Toolbox

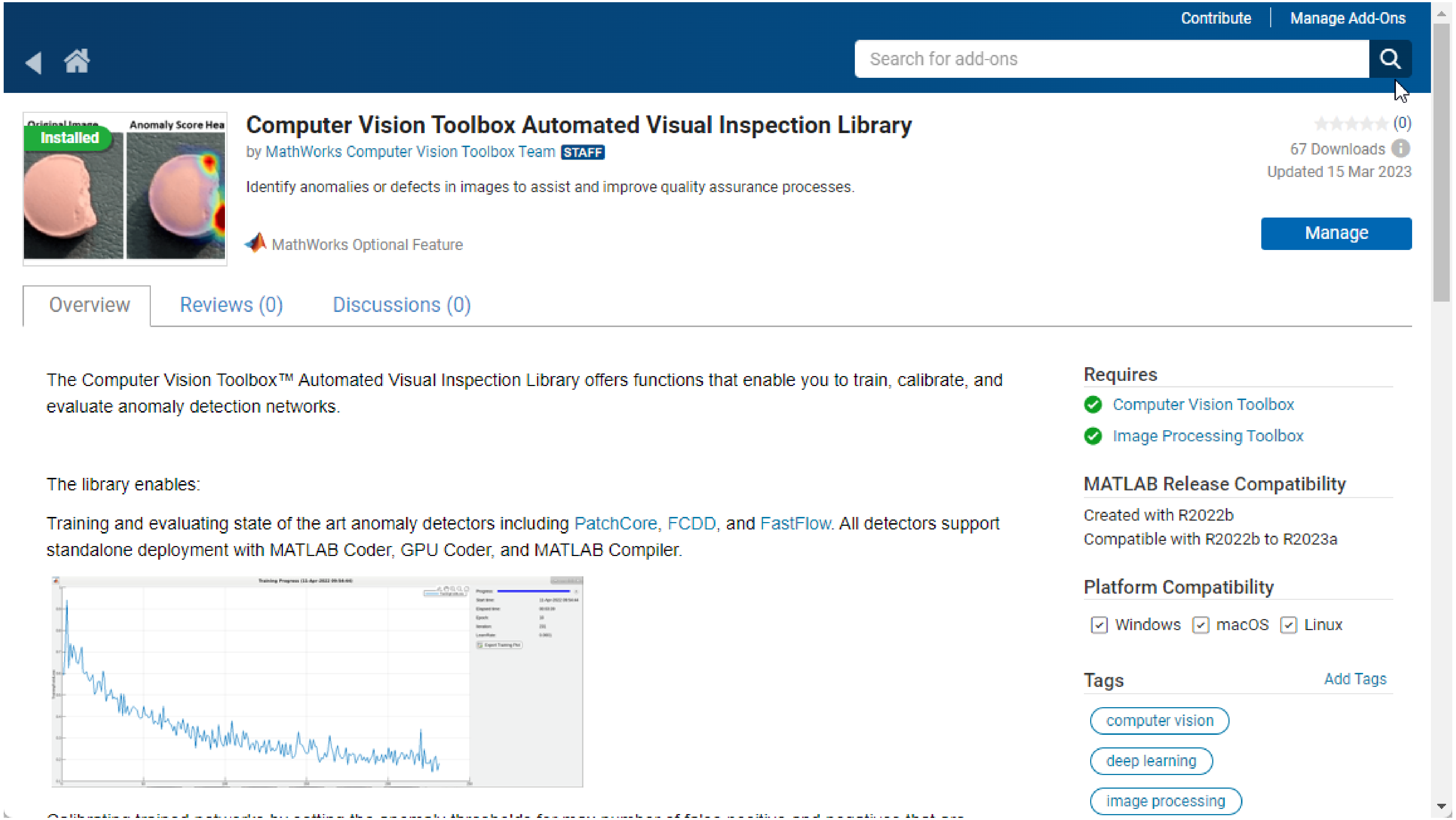
Computer Vision Toolbox

Deep Learning Toolbox

Statistics and Machine Learning Toolbox

…

MATLAB Algorithm Development



MATLAB Algorithm Development

Documentation Examples Functions Blocks Apps

Automated Visual Inspection

R2023a

Automate quality assurance tasks using anomaly detection and classification techniques

Automated visual inspection (AVI) is a set of techniques used to determine whether an image represents a normal ("good") state or an anomalous ("defective") state. AVI assists and improves quality assurance processes commonly found in manufacturing settings. Modern visual inspection uses machine learning and deep learning techniques to produce useful results.

The specific technique you select to automate a visual inspection task depends on several factors. These factors include the amount of training data available for normal and anomalous samples, the number of anomaly classes to recognize, and the type of localization information required for understanding and monitoring predictions.

To perform automated visual inspection, download the Computer Vision Toolbox™ Automated Visual Inspection Library from the Add-On Explorer. For more information on downloading add-ons, see Get and Manage Add-Ons. Some functionality also requires Deep Learning Toolbox™.

Functions

expand all

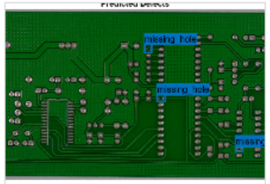
- Load Training Data
- Train Anomaly Detector
- Detect Anomalies Using Deep Learning
- Visualize and Evaluate Results

Topics

Getting Started with Anomaly Detection Using Deep Learning

Anomaly detection using deep learning is an increasingly popular approach to automating visual inspection tasks.

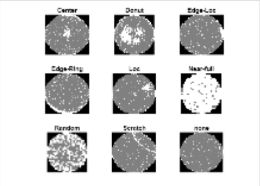
Featured Examples



Detect Defects on Printed Circuit Boards Using YOLO v4 Network

Detect, localize, and classify defects in printed circuit boards (PCBs) using a you only look once version 4 (YOLO v4) deep learning network.

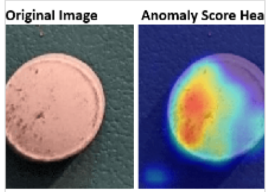
Open Live Script



Classify Defects on Wafer Maps Using Deep Learning

Classify manufacturing defects on wafer maps using a simple convolutional neural network (CNN).

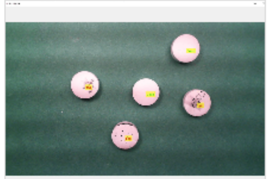
Open Live Script



Detect Image Anomalies Using Explainable FCDD Network

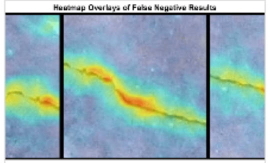
Use an anomaly detector to distinguish between normal pills and pills with anomalous chips or contamination.

Open Live Script



Detect Anomalies in Pills During Live Image Acquisition

Detect anomalies in pills during live image acquisition.



Detect Image Anomalies Using Pretrained ResNet-18 Feature Embeddings

Train a similarity-based anomaly detector using one-class learning of feature embeddings extracted from a pretrained ResNet-18

Open Live Script

MATLAB Algorithm Development

Documentation Examples Functions Blocks Apps

Automated Visual Inspection — Functions

Load Training Data

groundTruth	Ground truth label data
sceneLabelTrainingData	Create training data for scene classification from ground truth
splitAnomalyData	Split data into training, validation and testing sets for anomaly detection

Train Anomaly Detector

trainFCDDAnomalyDetector	Train fully convolutional data description (FCDD) anomaly detection network
trainFastFlowAnomalyDetector	Train FastFlow anomaly detection network
trainPatchCoreAnomalyDetector	Train PatchCore anomaly detection network
anomalyThreshold	Optimal anomaly threshold for set of anomaly scores and corresponding labels

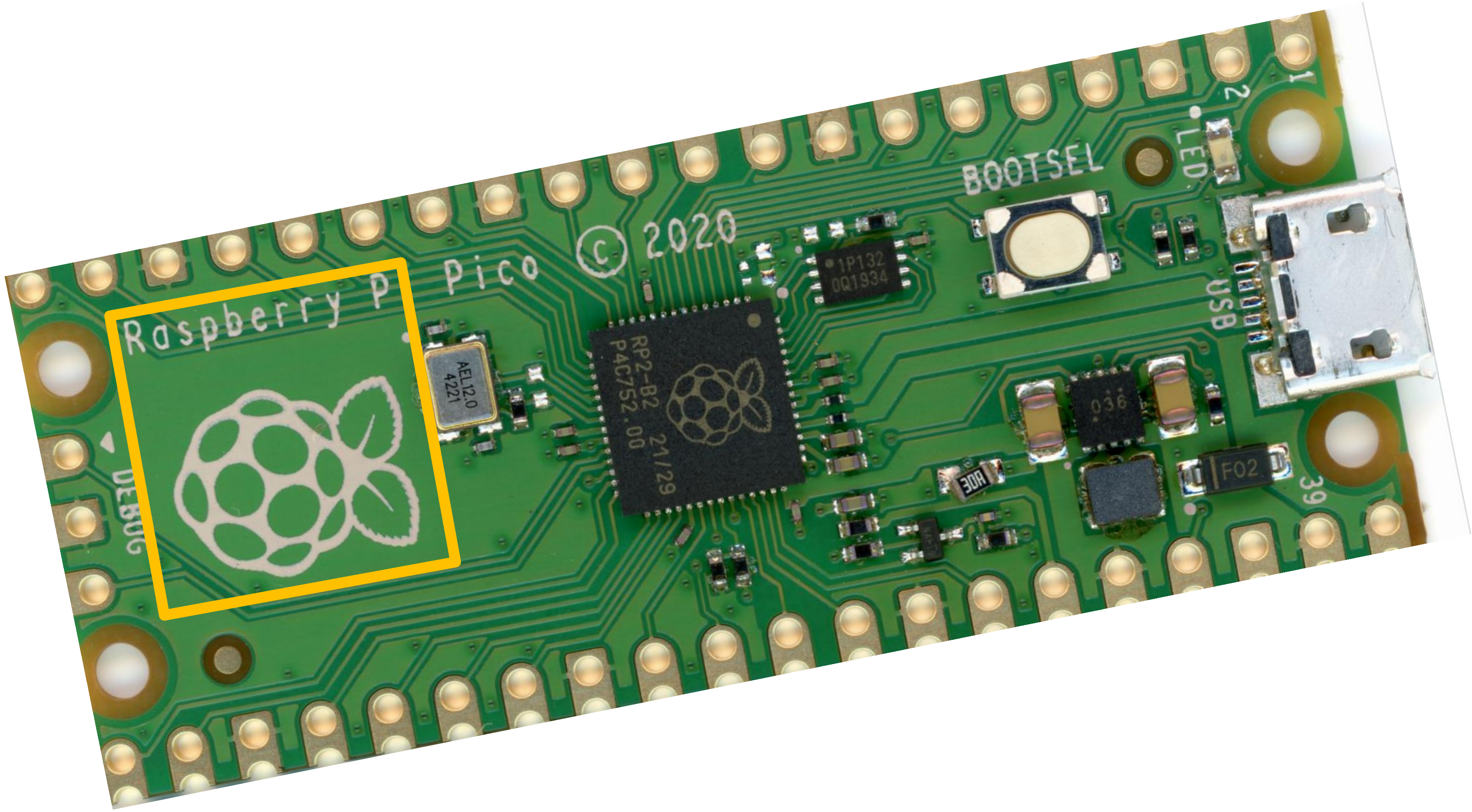
Detect Anomalies Using Deep Learning

fcddAnomalyDetector	Detect anomalies using fully convolutional data description (FCDD) network for anomaly detection
fastFlowAnomalyDetector	Detect anomalies using FastFlow network
patchCoreAnomalyDetector	Detect anomalies using PatchCore network
classify	Classify image as normal or anomalous
predict	Predict unnormalized anomaly scores

Visualize and Evaluate Results

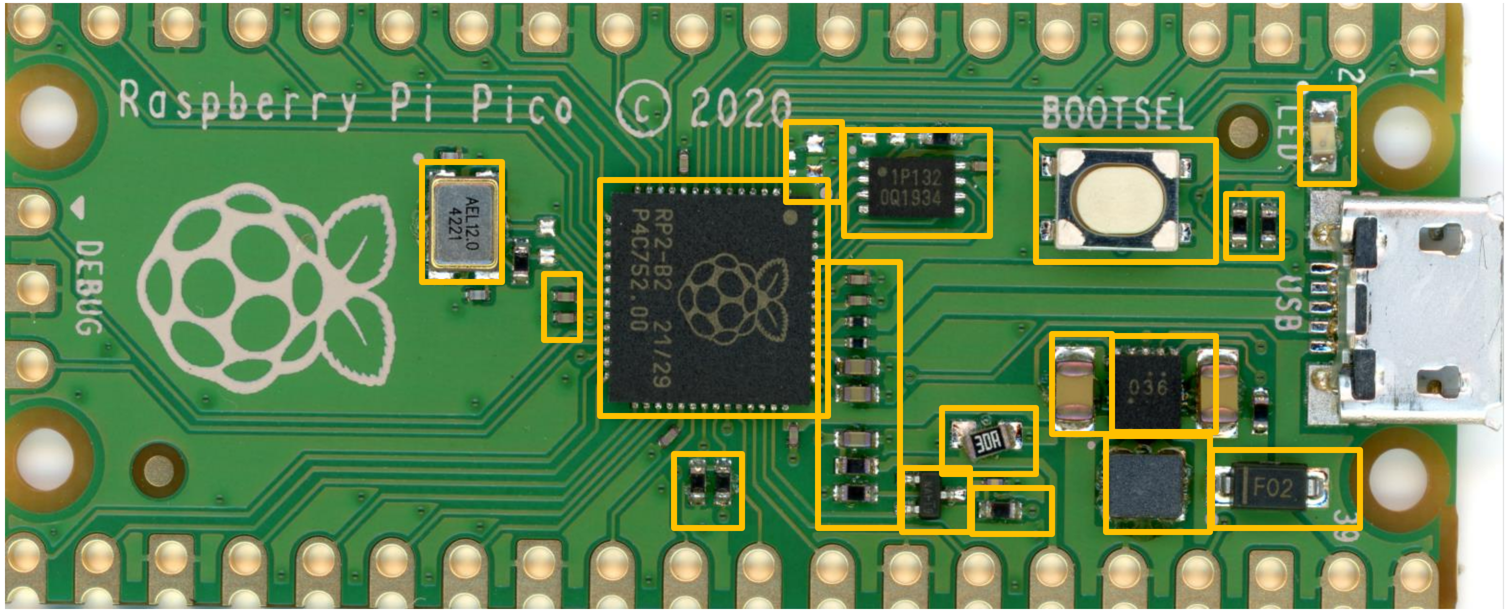
anomalyMap	Predict per-pixel anomaly score map
anomalyMapOverlay	Overlay heatmap on image using per-pixel anomaly scores
viewAnomalyDetectionResults	View anomaly detection results
evaluateAnomalyDetection	Evaluate anomaly detection results against ground truth
anomalyDetectionMetrics	Anomaly detection metrics

Sample Problem: Detecting Defects on a Raspberry Pi



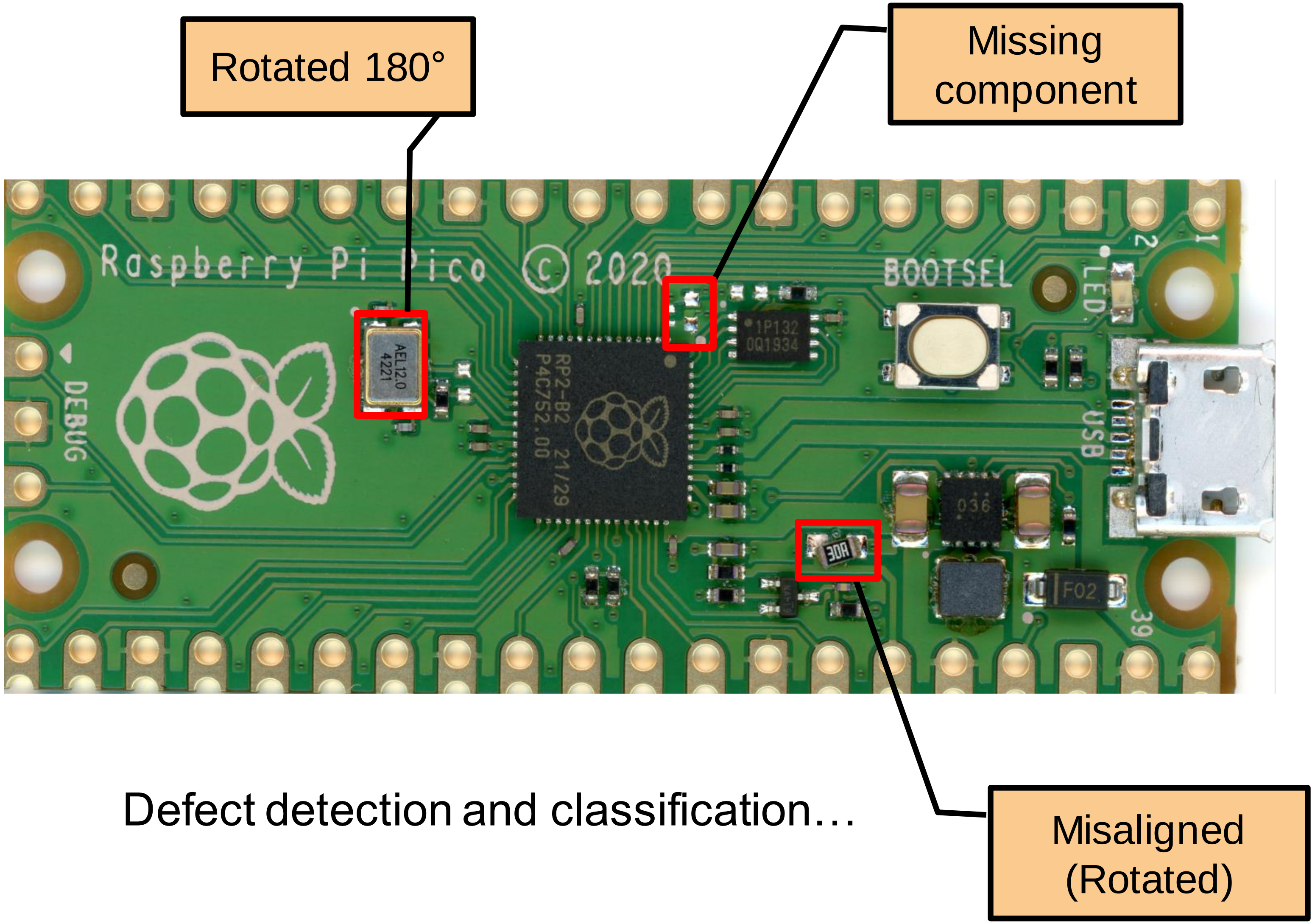
Template-based orientation and preprocessing…

Sample Problem: Detecting Defects on a Raspberry Pi



Component detection…

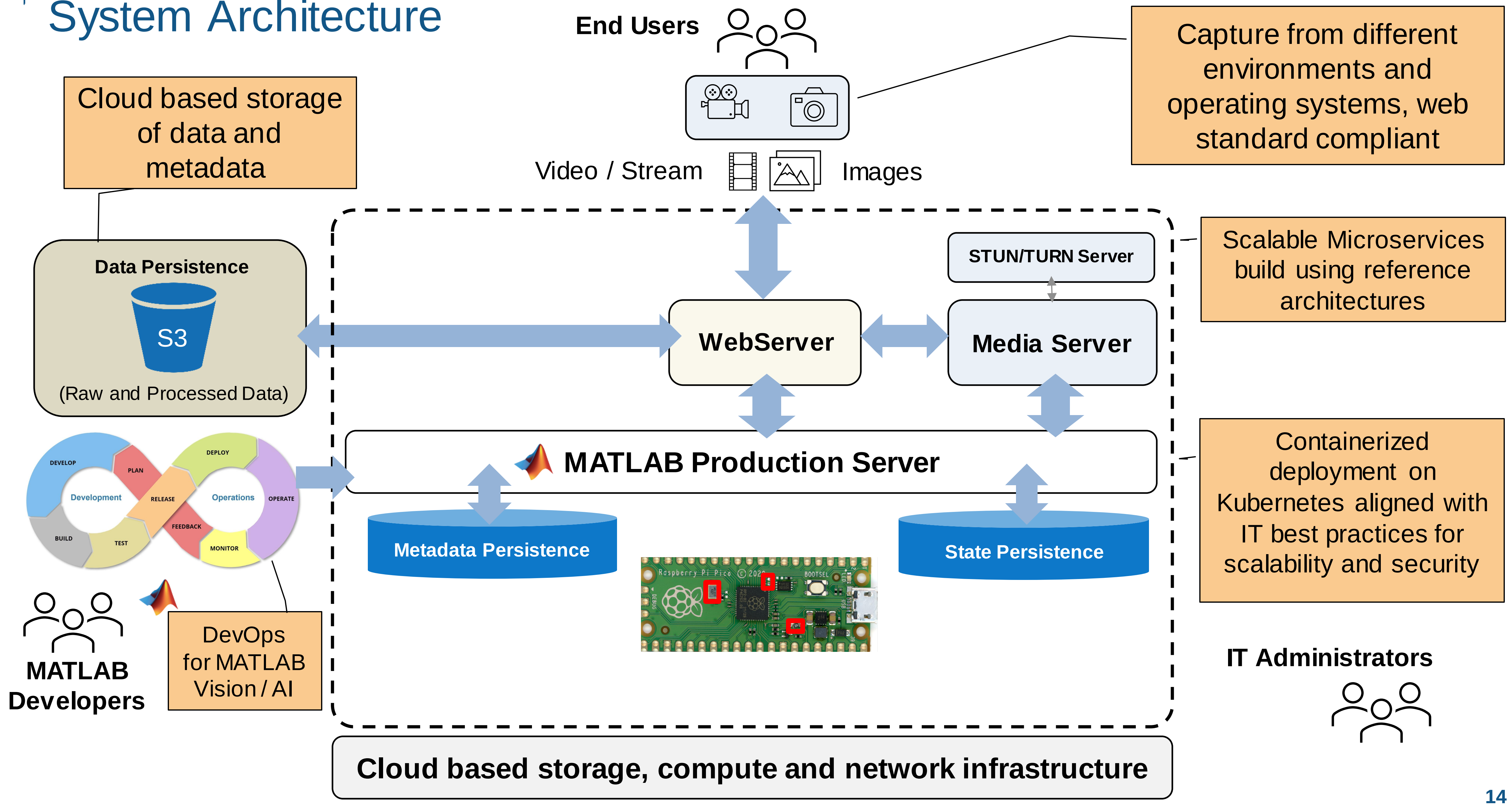
Sample Problem: Detecting Defects on a Raspberry Pi



Defect detection and classification…

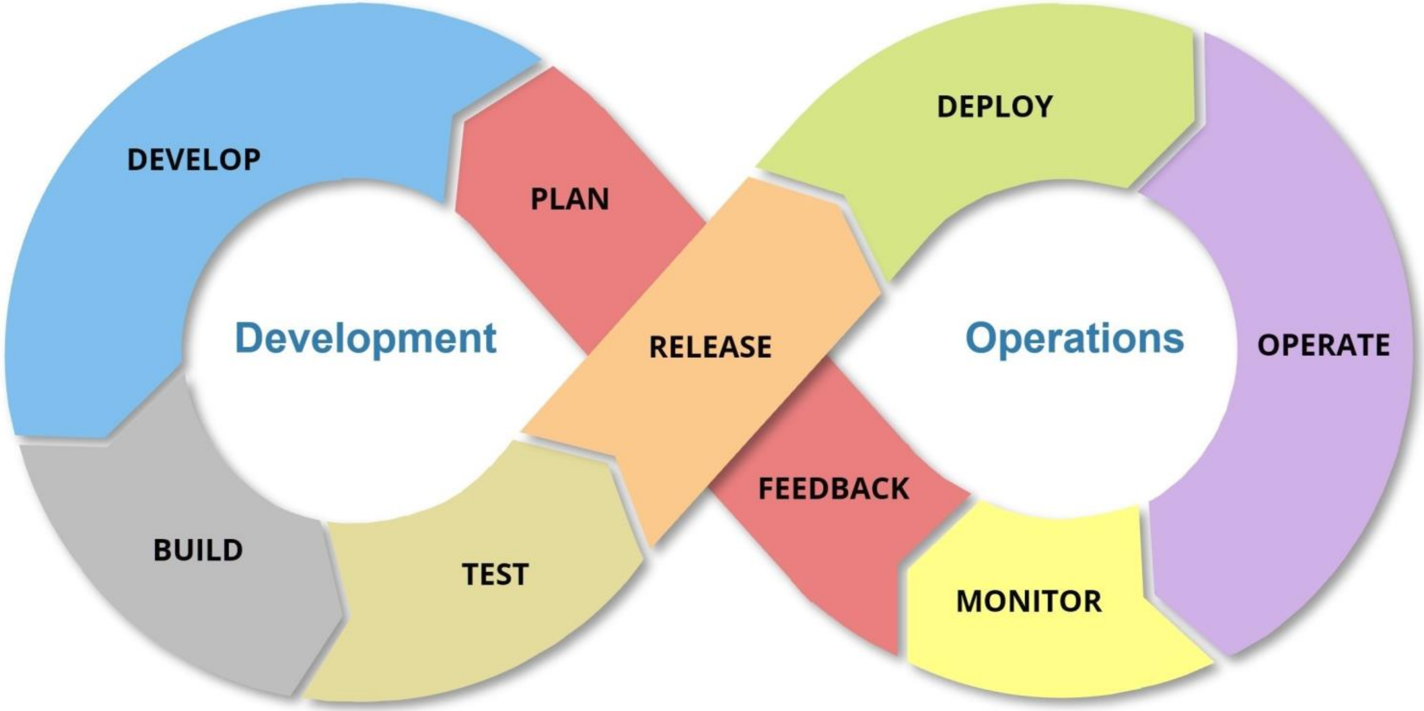
- QR-Code Triggering
- Live, Constrained Capture (iPhone, iPad, Android)
- Automatic updating of ground truth and model
- Scalable, Cloud-Based Analysis and Reporting

System Architecture

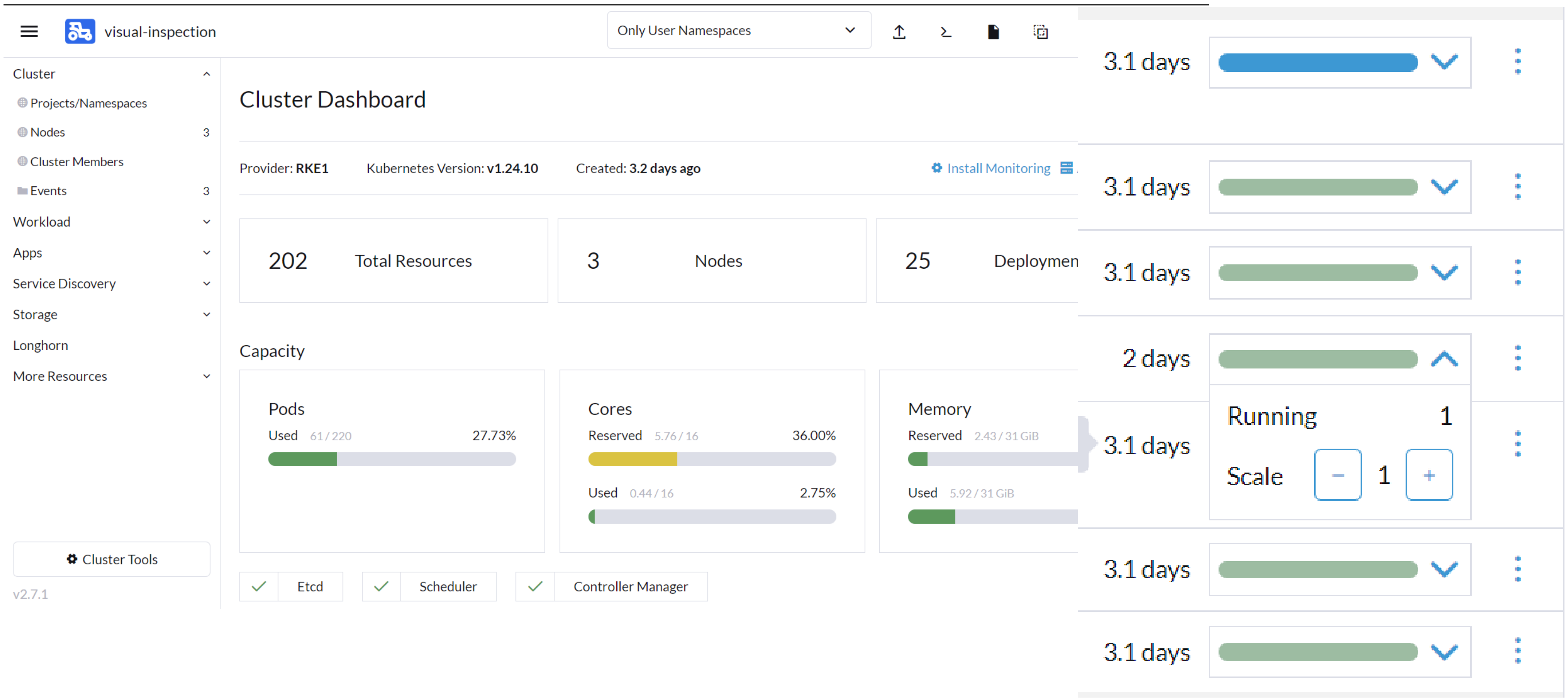


MATLAB from Prototype to Production

- Modern DevOps based automated continuous deployment of MATLAB applications



MATLAB Deployment and Scaling



Take-aways and Conclusion

- MathWorks products along with published reference architectures can be leveraged to build production-grade visual inspection systems for the cloud
- Secure, scalable and agile solutions for AI/Visual Inspection can be built to IT DevOps best practices
- Domain specific toolboxes and support packages are available for MATLAB users to go from prototype to production quickly

Q & A

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Thank you

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