MATLAB EXPO

基于云的MATLAB视觉检查系统

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MathWorks®

什么是自动视觉检查

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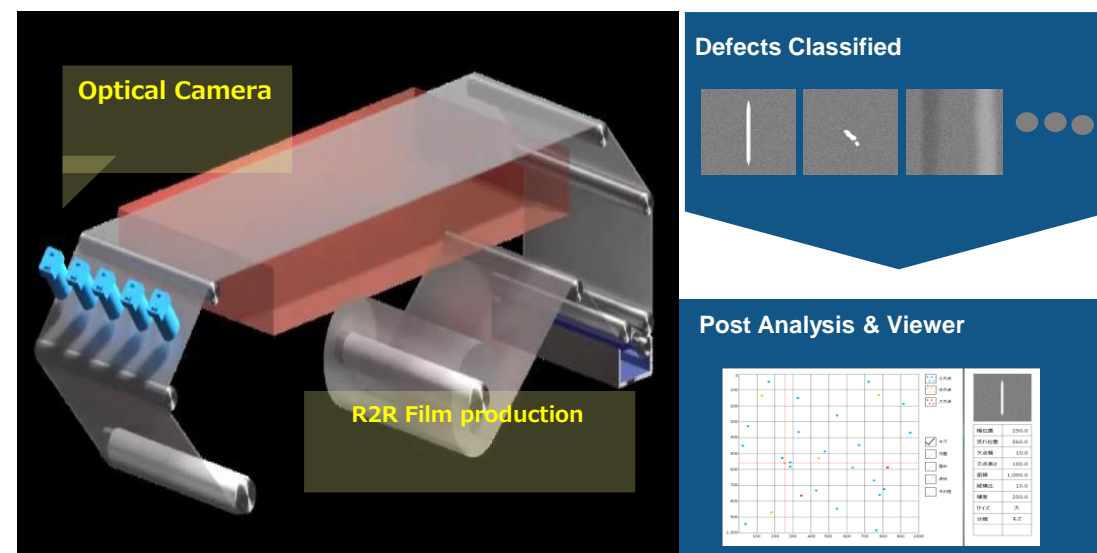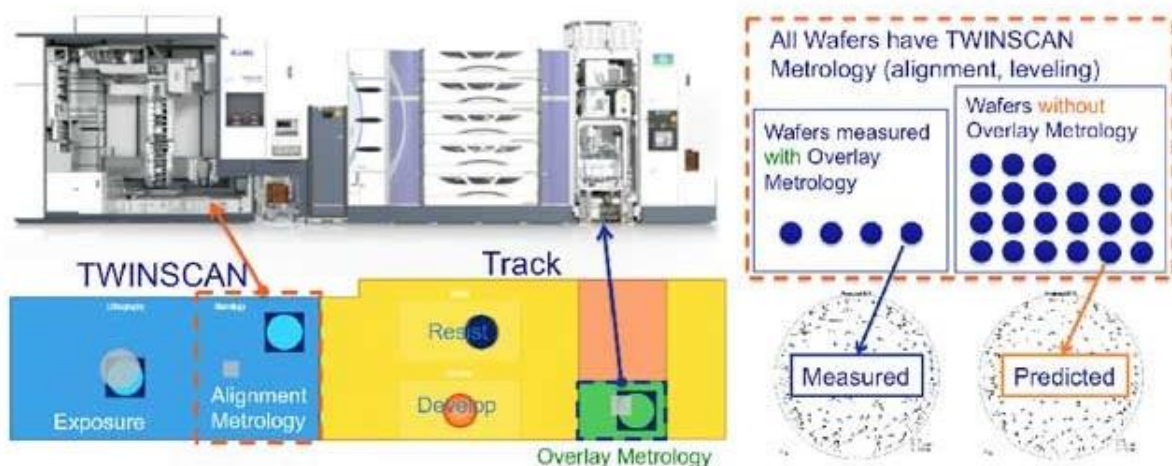
Automated Defect Detection

Machine Vision   Optical Inspection

Automated Inspection

MATLAB 自动视觉检查应用案例

Metrology Technology for Semiconductor Manufacturing

Film Production Inspection

基于云的视觉检查系统中的 MATLAB AI

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
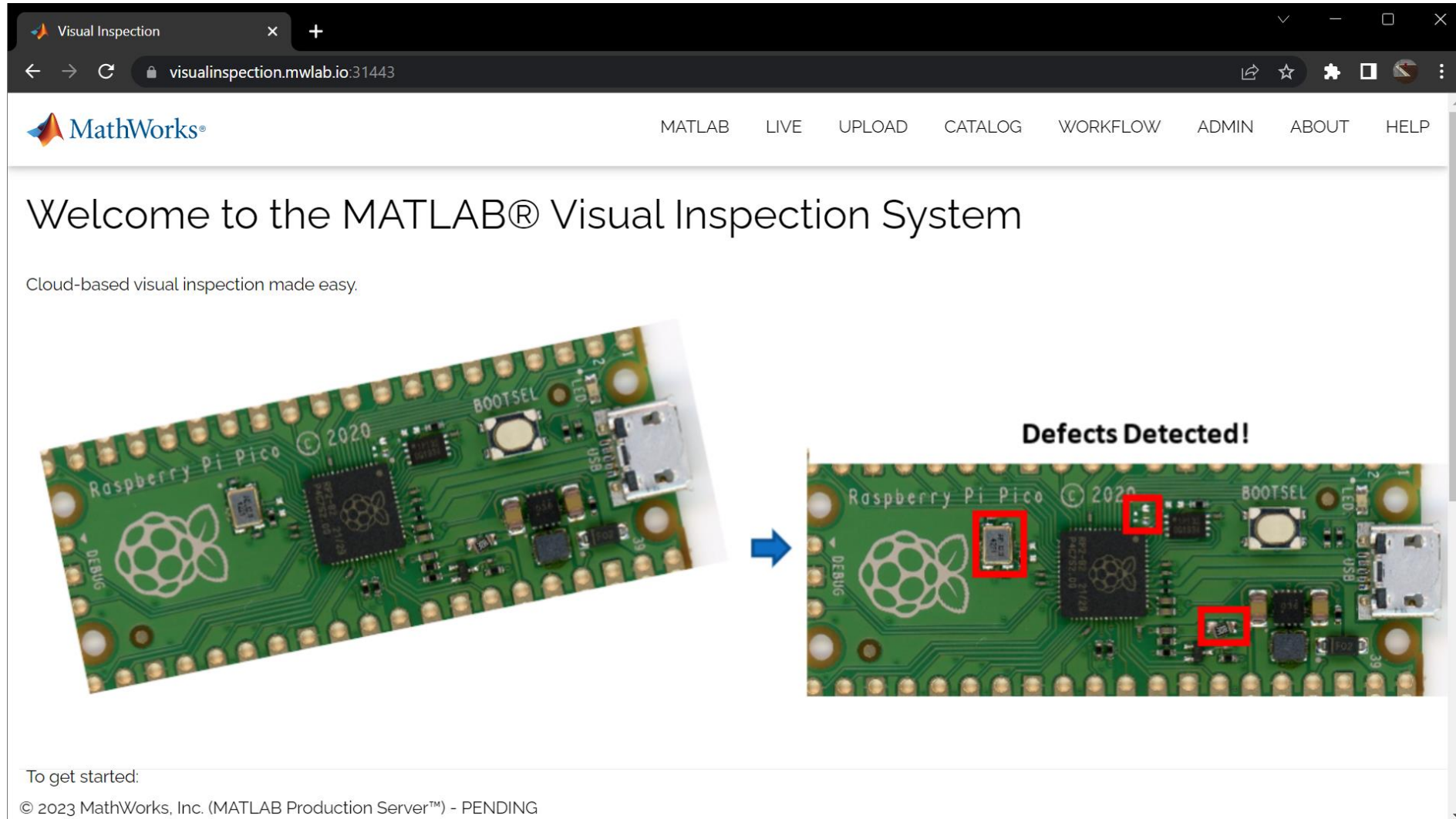
示例问题：检测和表征树莓派上的缺陷
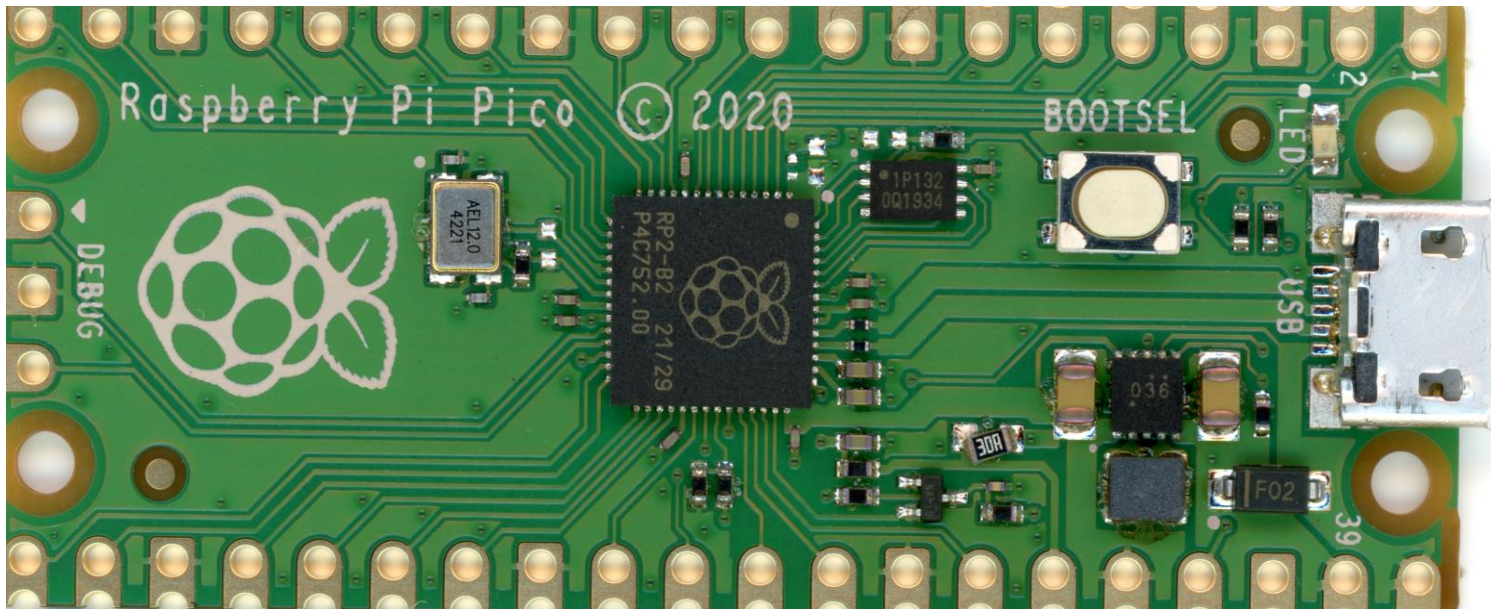
Potential defects* include:

- Misaligned components

- Bad assembly

- Damage

- Missing Solder

- Labeling mistakes

- Other?

NOTE: Defects were artificially introduced for this demonstration.

示例演示

A Cloud-based MATLAB Visual Inspection System

系统架构和概述

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
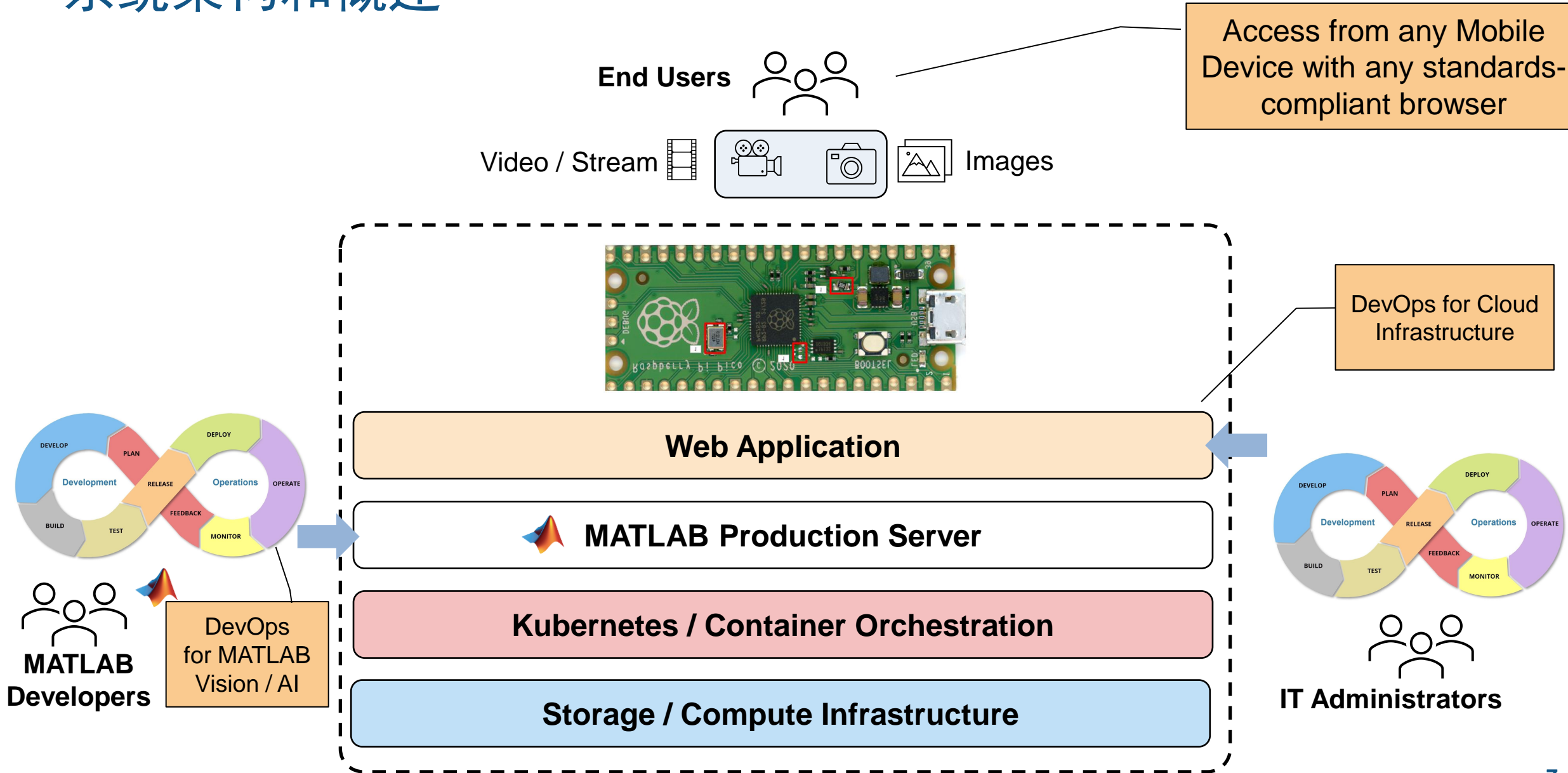
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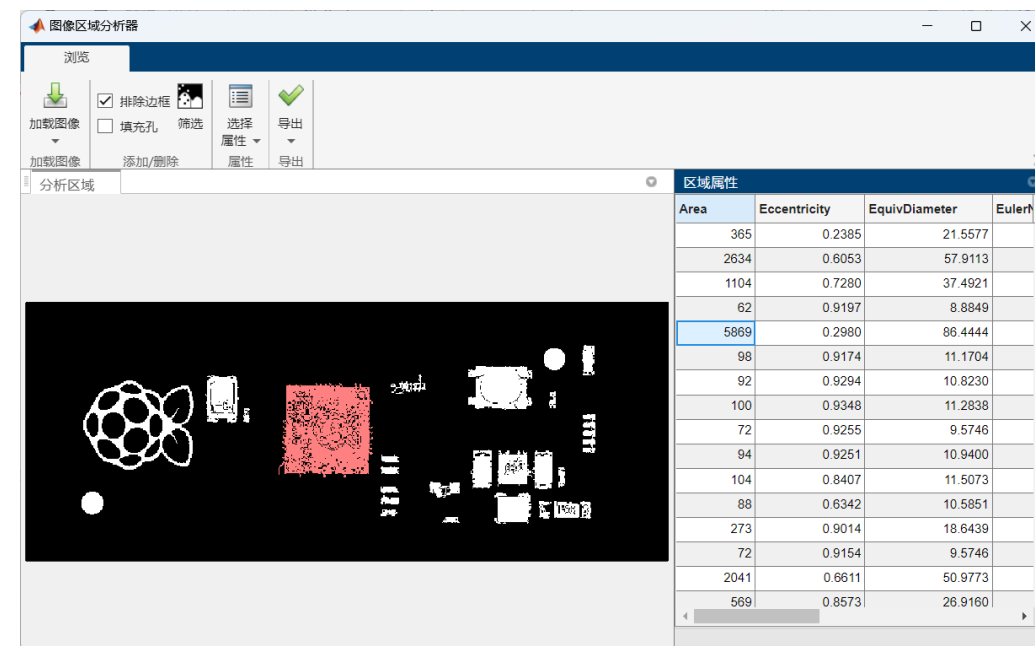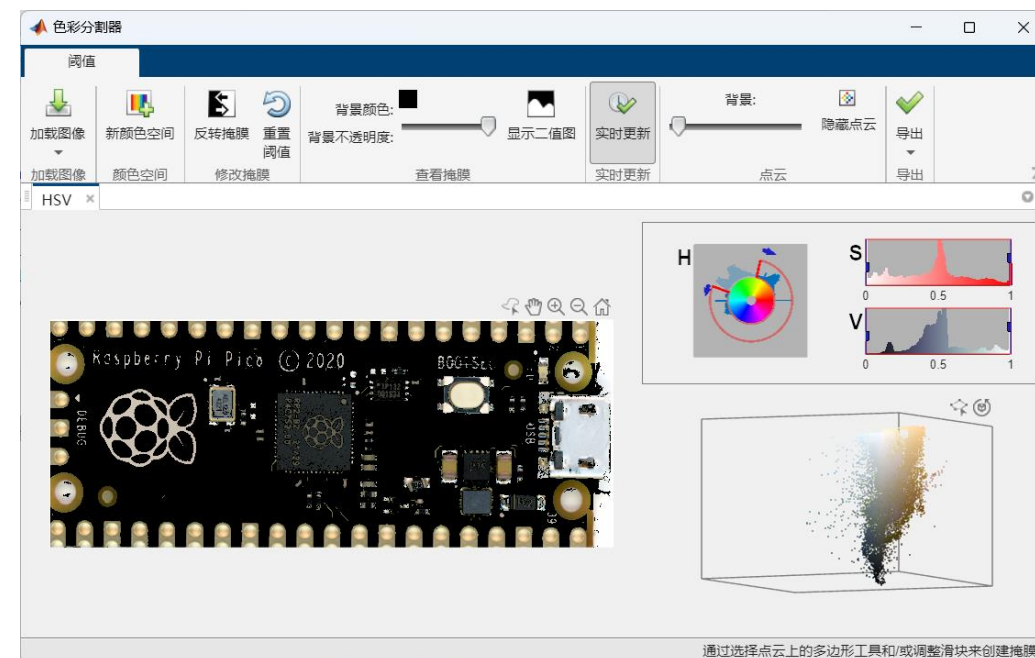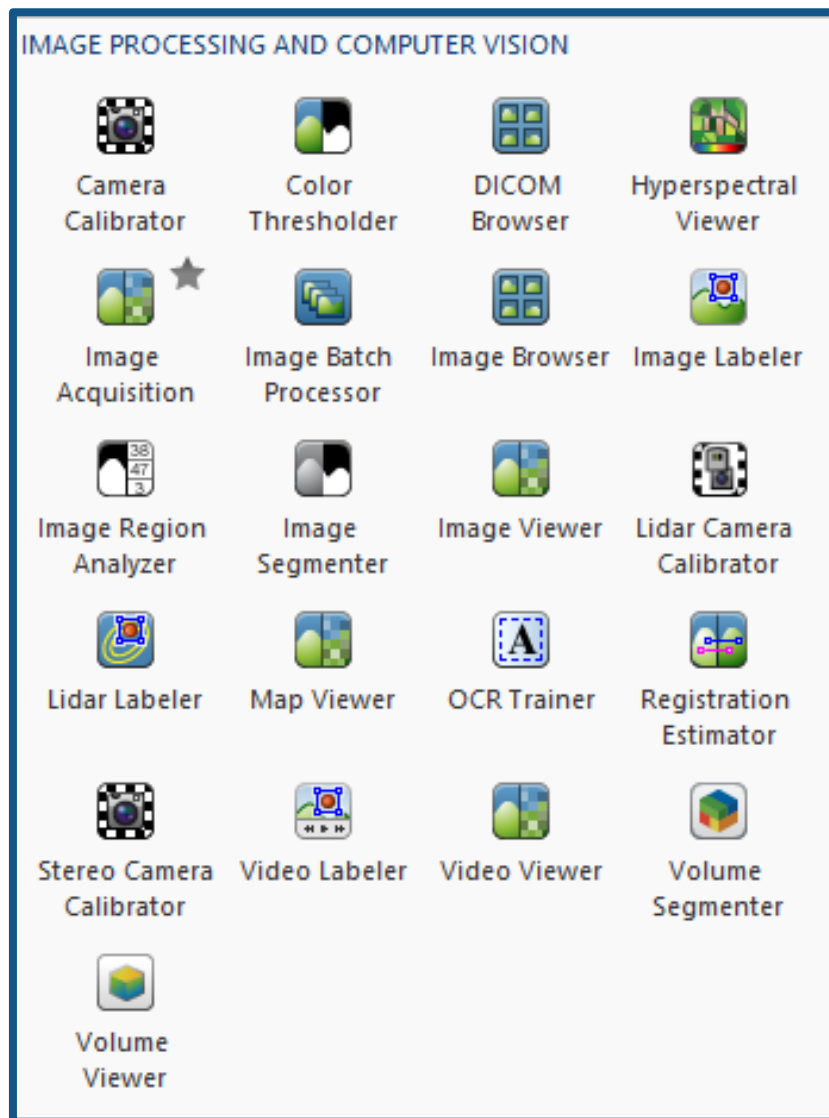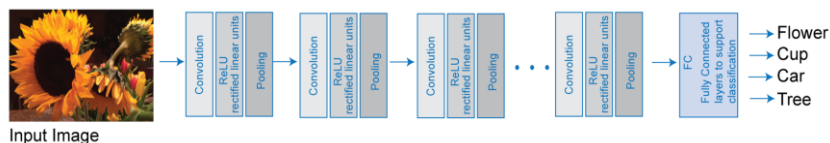Image Processing Toolbox
Computer Vision Toolbox
Deep Learning Toolbox
Statistics and Machine Learning Toolbox

…

用于视觉检查的图像处理APP

用于视觉检查的深度模型架构
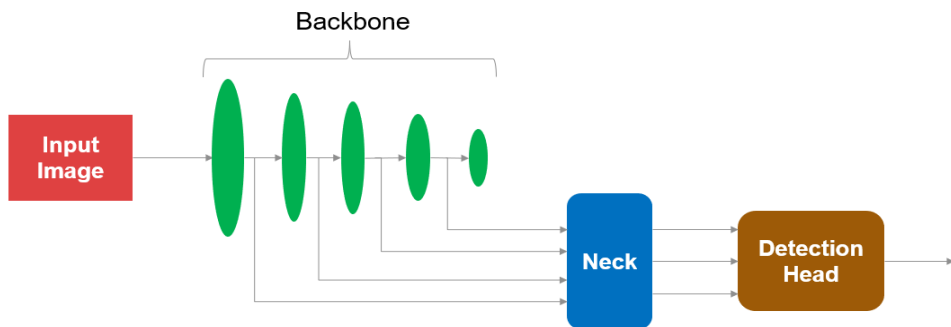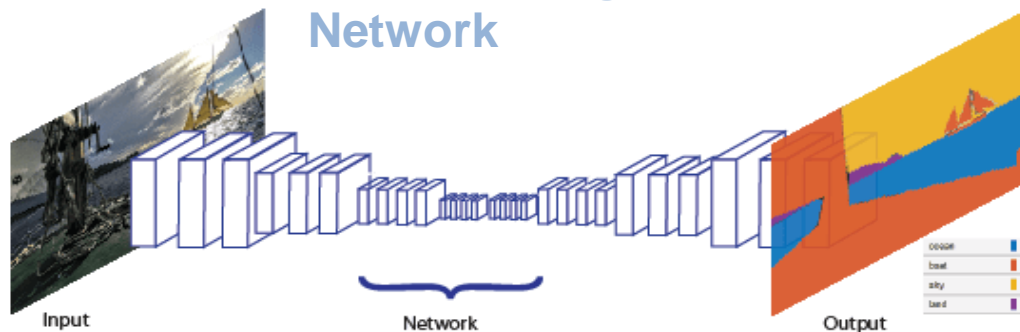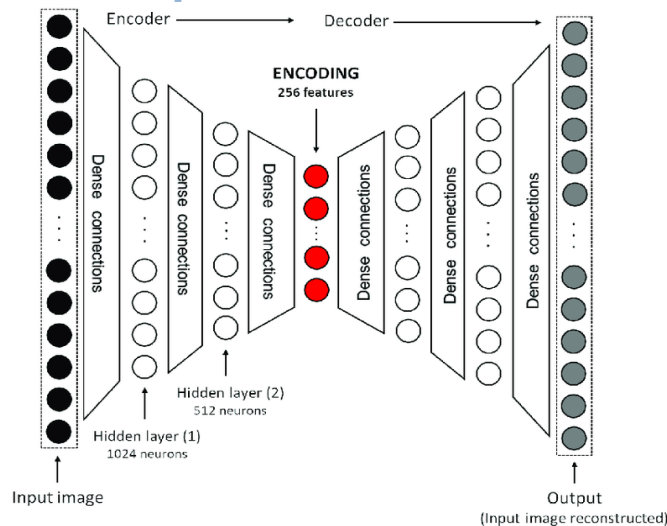

Convolutional Neural Networks

YOLO – Object Detector

Deep Autoencoder

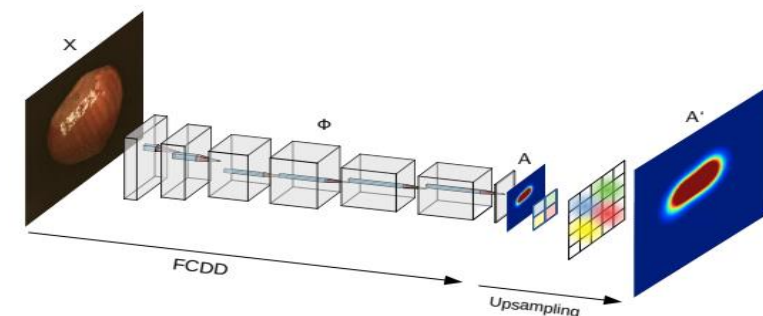**Semantic Segmentation Network**

Fully Convolutional Data Description (FCDD) – Anomaly Detector

Generative Adversarial Network (GAN)

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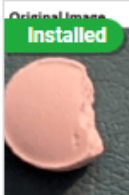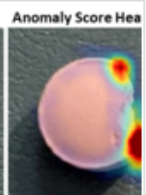
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Documentation Examples Functions Blocks Apps

Automated Visual Inspection
Automate quality assurance tasks using anomaly detection and classification techniques

R2023a

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

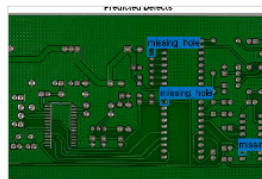> Train Anomaly Detector

> 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
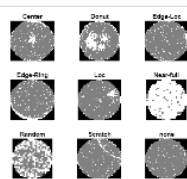
Classify Defects on Wafer Maps Using Deep Learning

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

Open Live Script
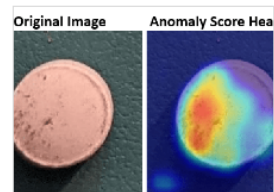
Detect Image Anomalies Using Explainable FCDD Network

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

Open Live Script
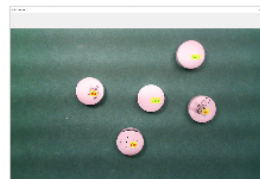
Detect Anomalies in Pills During Live Image Acquisition

Detect anomalies in pills during live image acquisition.
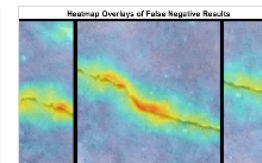
Open Live Script

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

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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

示例问题：检测和表征树莓派上的缺陷
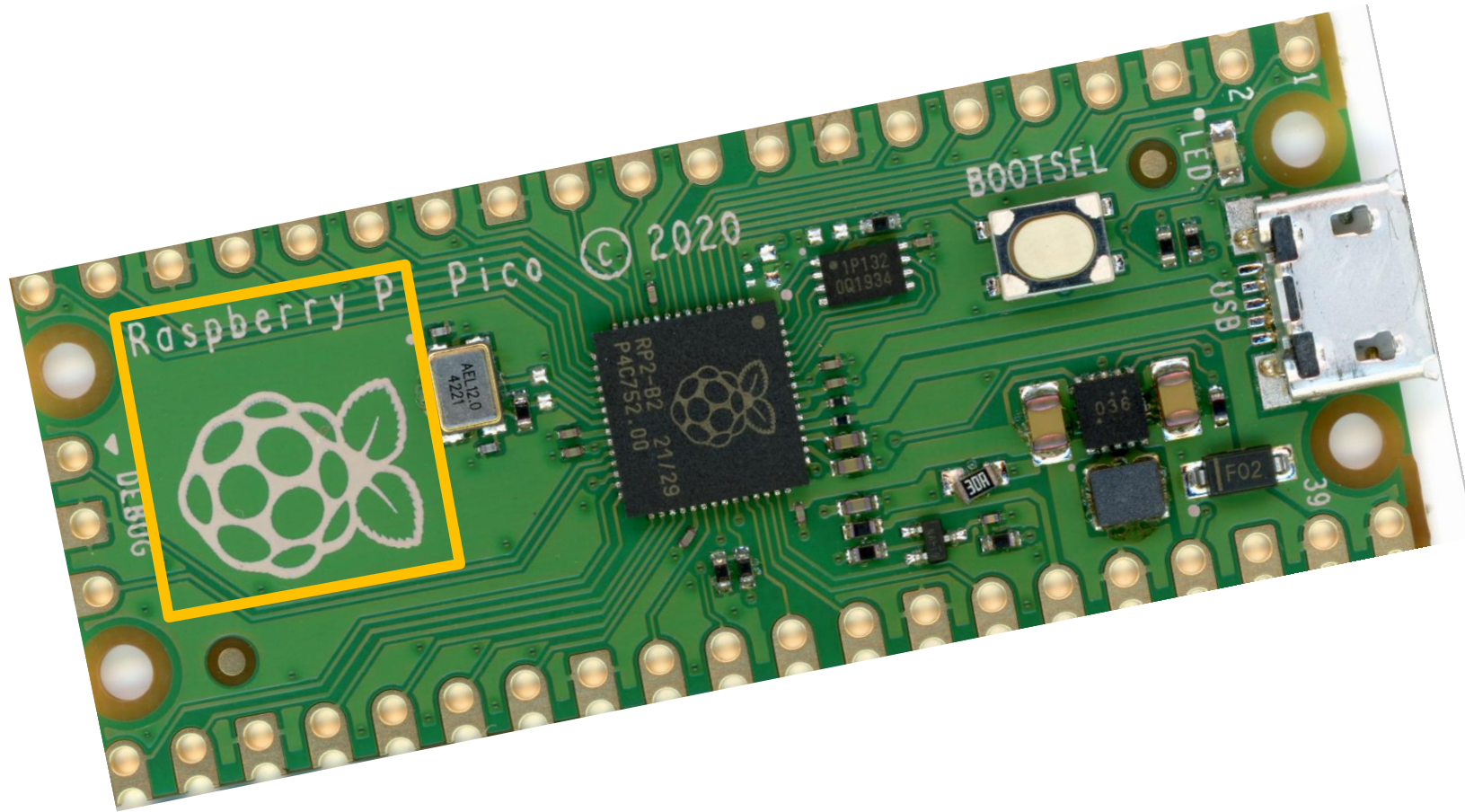
Template-based orientation and preprocessing…

示例问题：检测和表征树莓派上的缺陷
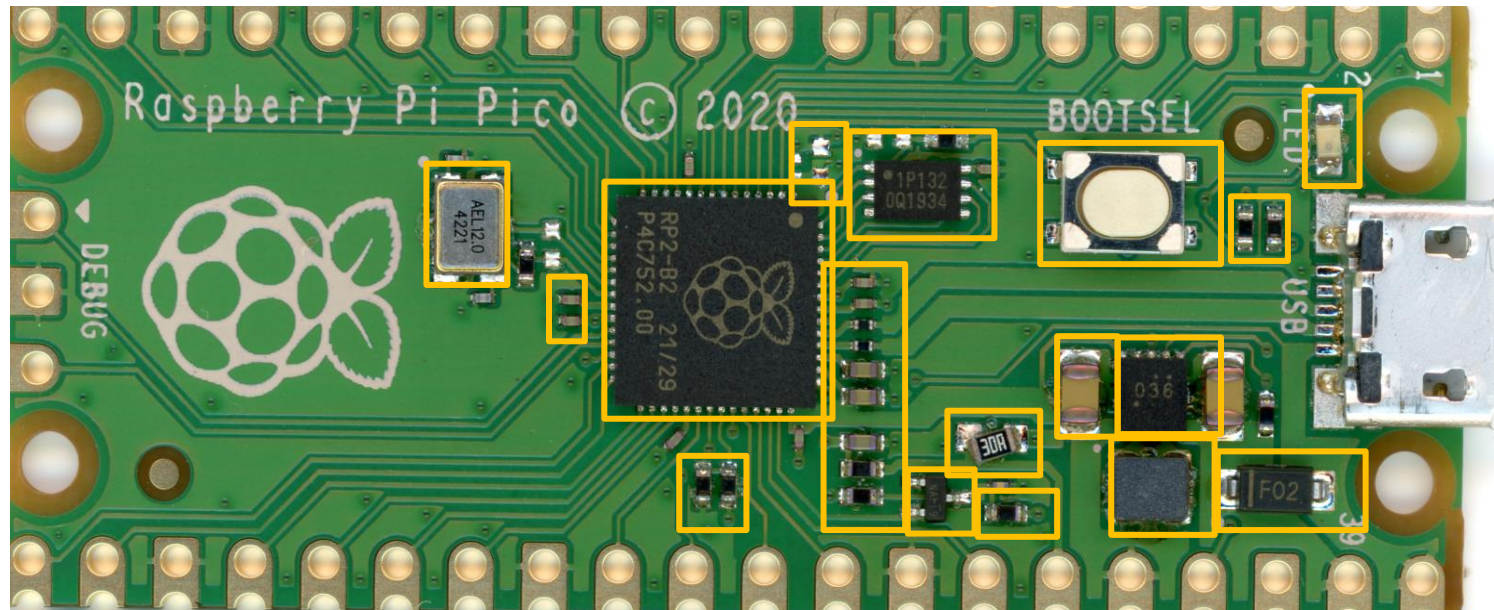
Component detection…

示例问题：检测和表征树莓派上的缺陷
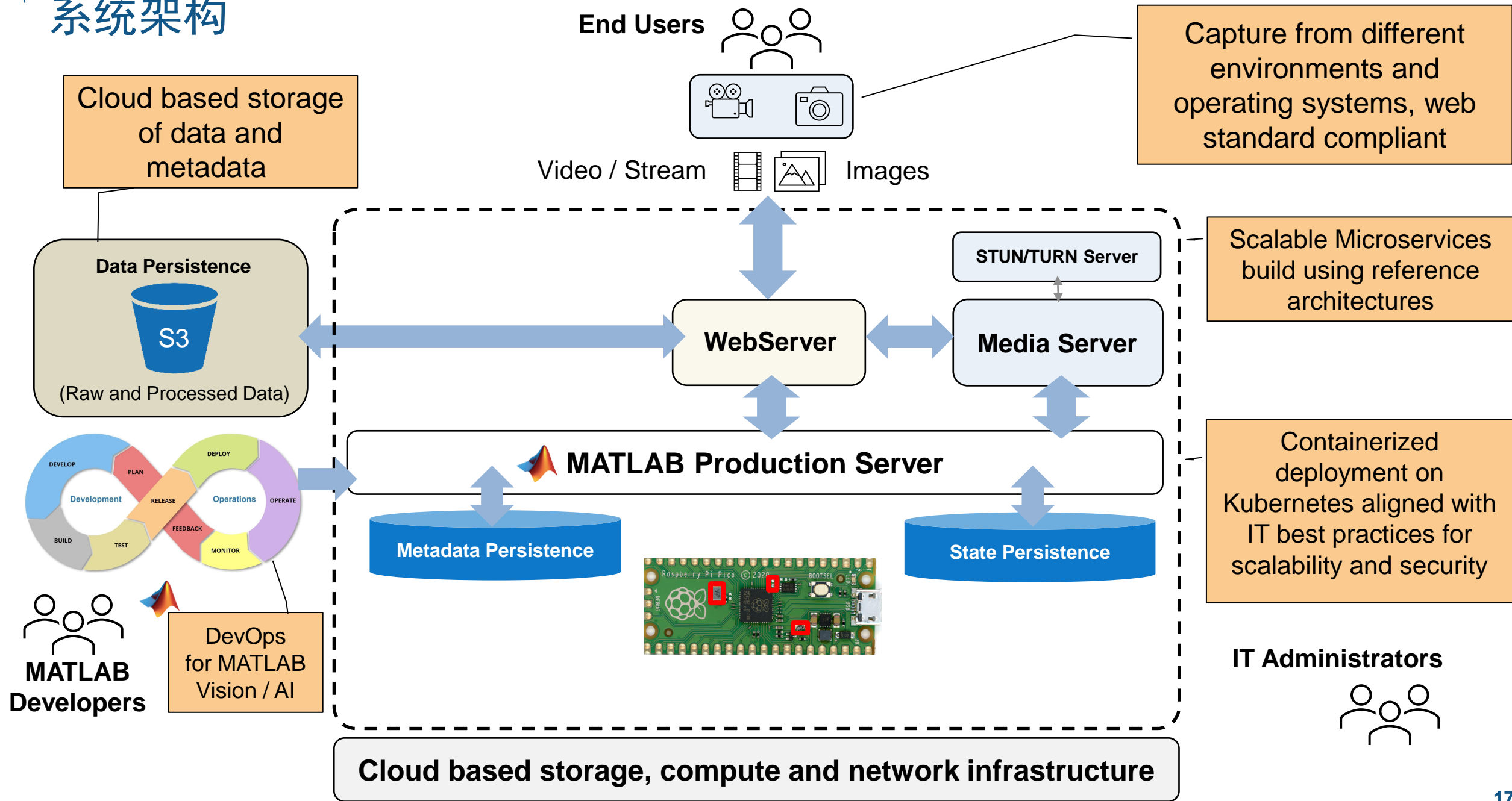

Rotated 180°

Missing component

Misaligned (Rotated)
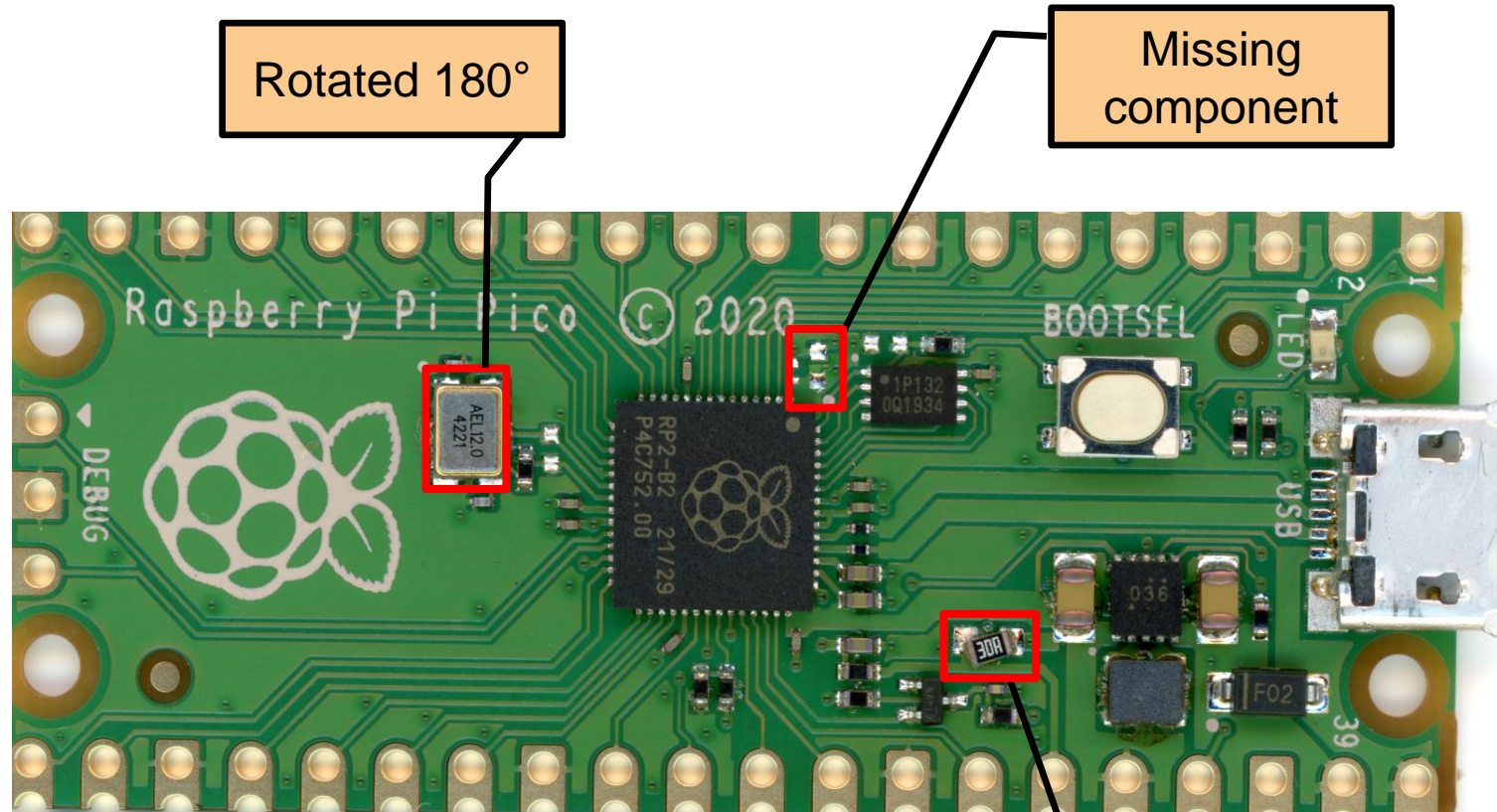
Defect detection and classification…

- QR-Code Triggering

- Live, Constrained Capture (iPhone, iPad)

- Automatic updating of ground truth and model

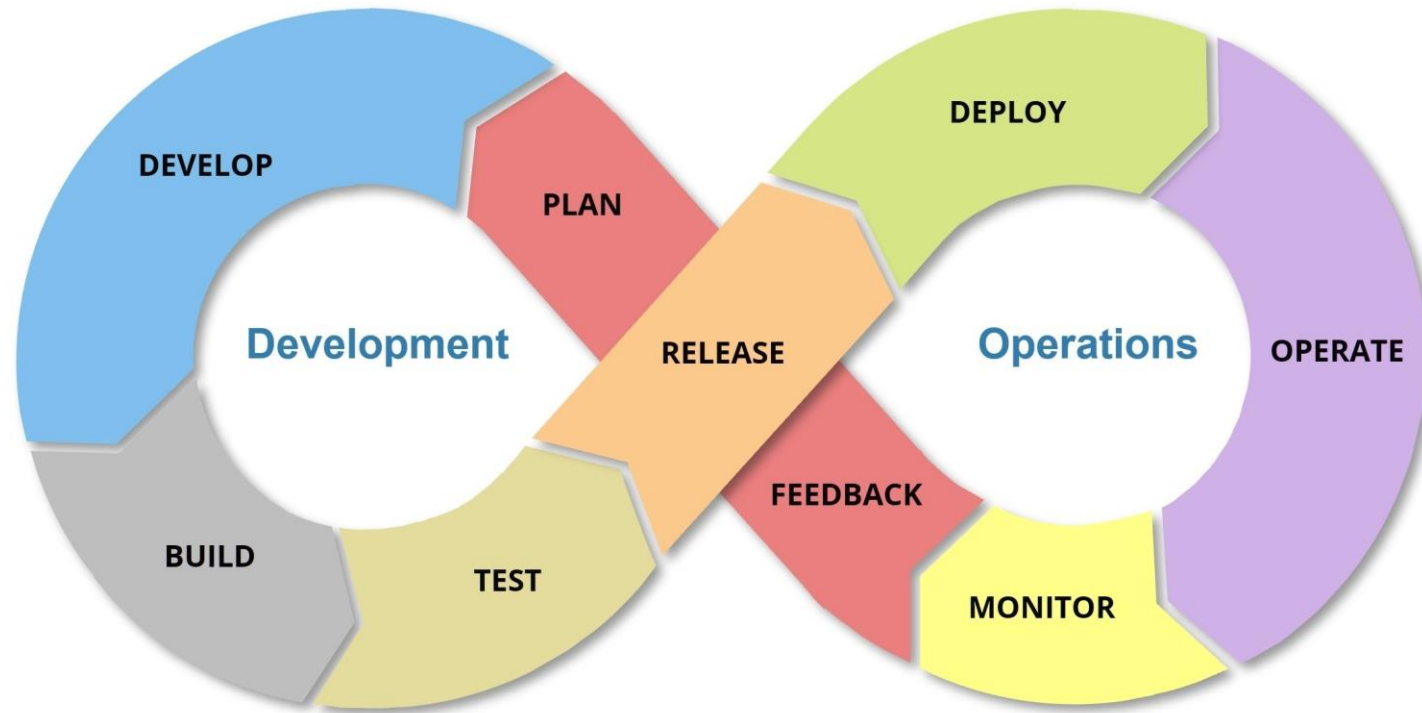- Scalable, Cloud-Based Analysis and Reporting

系统架构

End Users

Video / Stream 🎞️ 🖼️ Images

Cloud based storage of data and metadata

Capture from different environments and operating systems, web standard compliant

Data Persistence

S3

(Raw and Processed Data)

Scalable Microservices build using reference architectures

STUN/TURN Server

WebServer ↔ **Media Server**

MATLAB Production Server

Metadata Persistence

State Persistence

Containerized deployment on Kubernetes aligned with IT best practices for scalability and security

DEVELOP · PLAN · DEPLOY · Development · RELEASE · Operations · OPERATE · BUILD · TEST · FEEDBACK · MONITOR

MATLAB Developers

DevOps for MATLAB Vision / AI

IT Administrators

Cloud based storage, compute and network infrastructure

使用 MATLAB 从原型到生产

- Modern DevOps based automated continuous deployment of MATLAB applications

MATLAB 部署和扩展

要点和结论

- 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

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Thank you

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