

# Lecture 3-4

## 21COE02 – MACHINE VISION

Prof. Harsh Kapadia

Assistant Professor

Electronics and Instrumentation Engineering Department

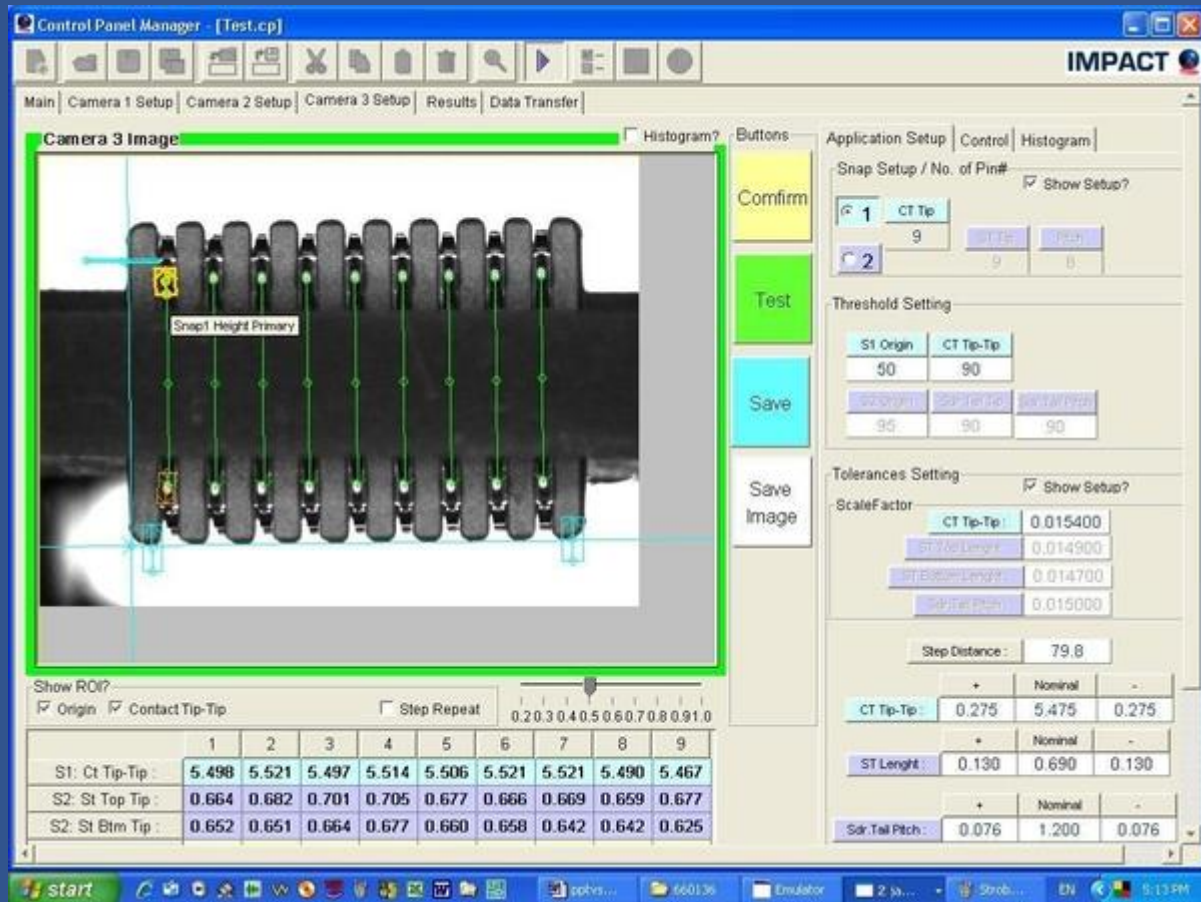
Institute of Technology Nirma university



# UNIT 1: Introduction to machine vision and its applications

- Fundamentals of machine vision
- Components of a machine vision system
- Basic problem of vision: four approaches
  - Brief history
  - Application examples

# Fundamentals of machine vision



# Fundamentals of machine vision

When to Deploy

Traditional Machine Vision vs. Deep Learning-Based Image Analysis

Gauging and measurement



Barcode reading and identification



Presence/absence



Robotic guidance



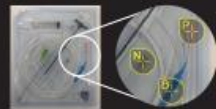
Inspection and defect detection



OCR



Part and feature location



Counting



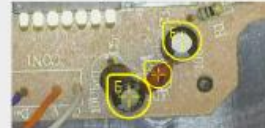
Complex cosmetic inspection and segmentation



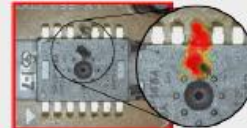
Texture and material classification



Assembly verification



Deformed and variable feature location



Challenging OCR, including distorted print



# Fundamentals of machine vision

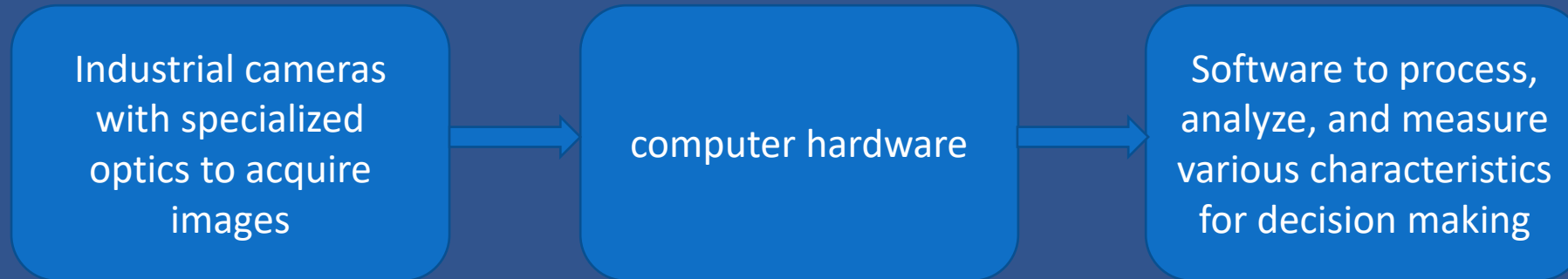
- According to the Automated Imaging Association (AIA), machine vision encompasses all industrial and non-industrial applications in which a combination of hardware and software provide operational guidance to devices in the execution of their functions based on the capture and processing of images.
- Though industrial computer vision uses many of the same algorithms and approaches as academic/educational and governmental/military applications of computer vision, constraints are different.



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- Though industrial computer vision uses many of the same algorithms and approaches as academic/educational and governmental/military applications of computer vision, constraints are different.
- Industrial vision systems demand greater robustness, reliability, and stability compared with an academic/educational vision system and typically cost much less than those used in governmental/military applications. Therefore, industrial machine vision implies low cost, acceptable accuracy, high robustness, high reliability, and high mechanical, and temperature stability

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# Fundamentals of machine vision

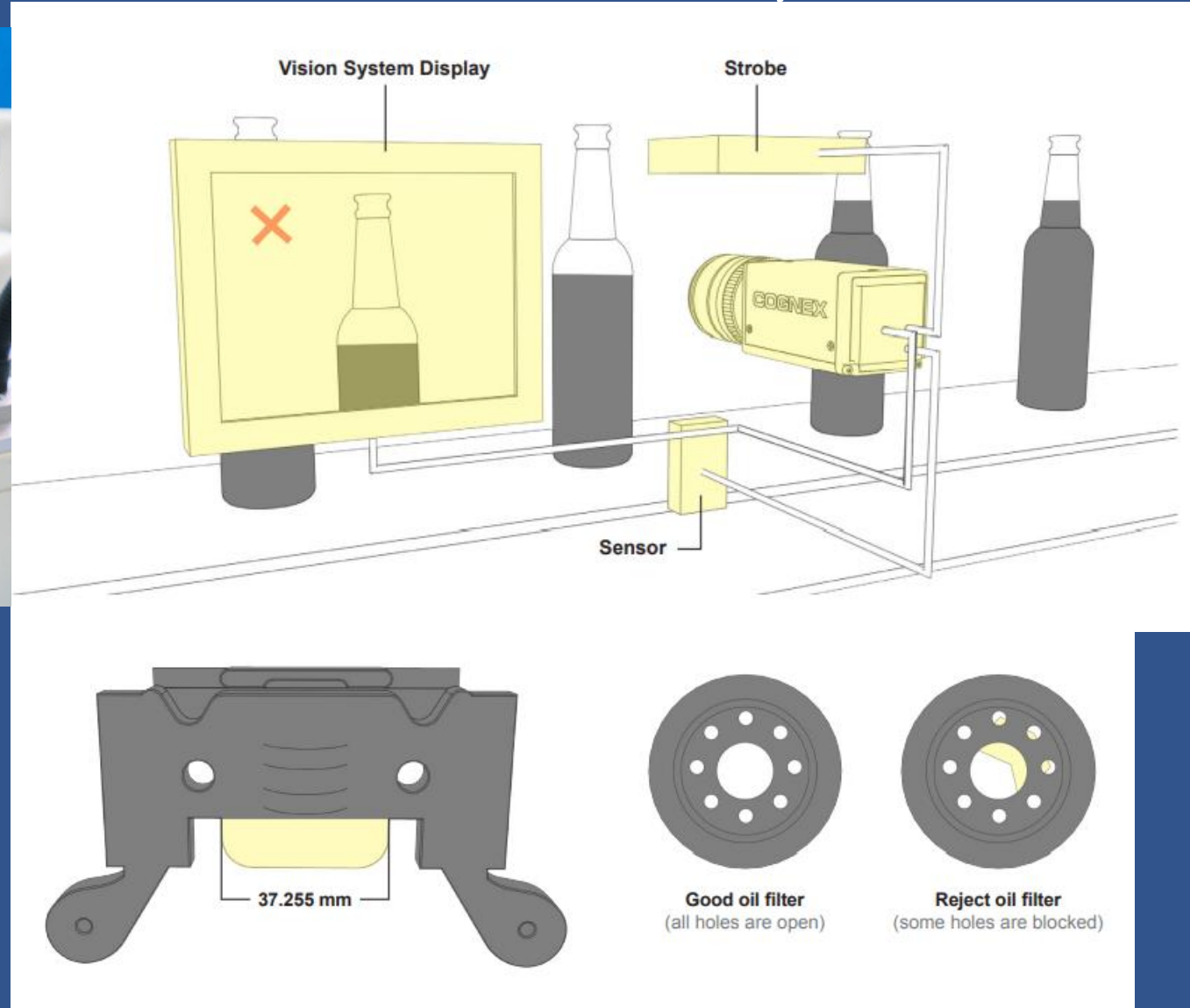
Strategic Goal	Machine Vision Applications
Higher quality	Inspection, measurement, gauging, and assembly verification
Increased productivity	Repetitive tasks formerly done manually are now done by Machine Vision System
Production flexibility	Measurement and gauging / Robot guidance / Prior operation verification
Less machine downtime and reduced setup time	Changeovers programmed in advance
More complete information and tighter process control	Manual tasks can now provide computer data feedback
Lower capital equipment costs	Adding vision to a machine improves its performance, avoids obsolescence
Lower production costs	One vision system vs. many people / Detection of flaws early in the process
Scrap rate reduction	Inspection, measurement, and gauging
Inventory control	Optical Character Recognition and identification
Reduced floorspace	Vision system vs. operator



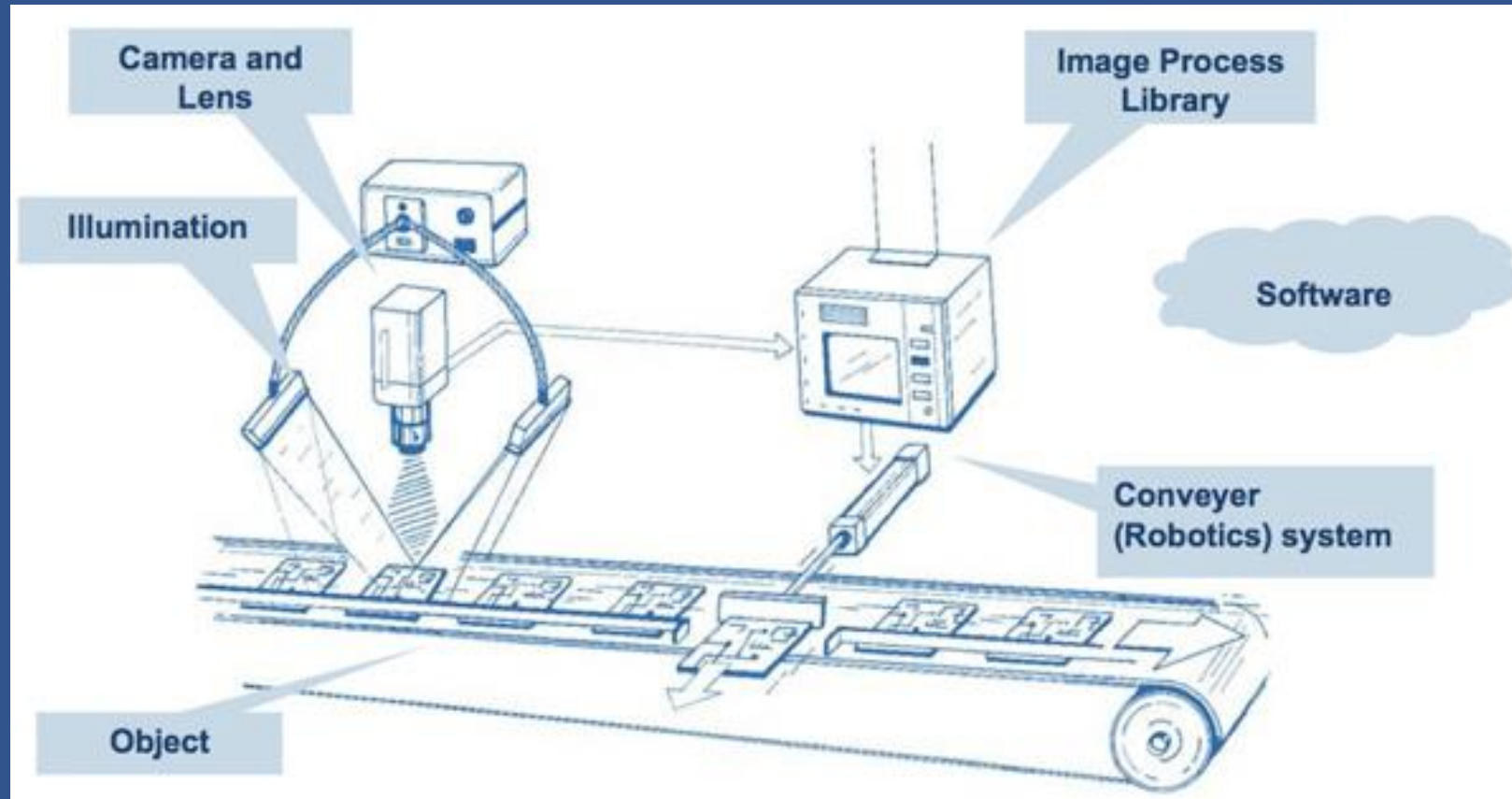
# Components of a machine vision system



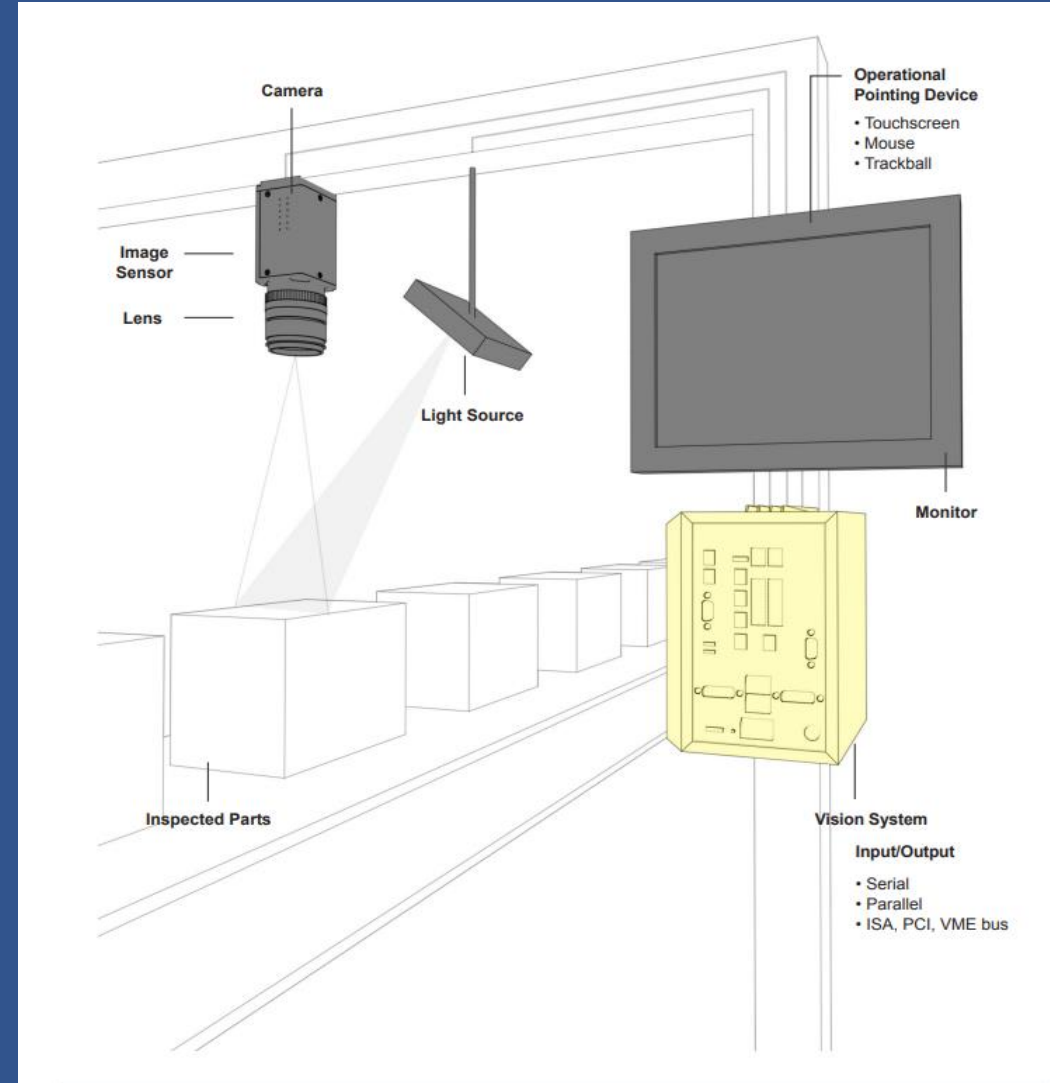
<https://cxvglobal.com/machine-vision-and-robotics/vision-application-types/>



# Components of a machine vision system

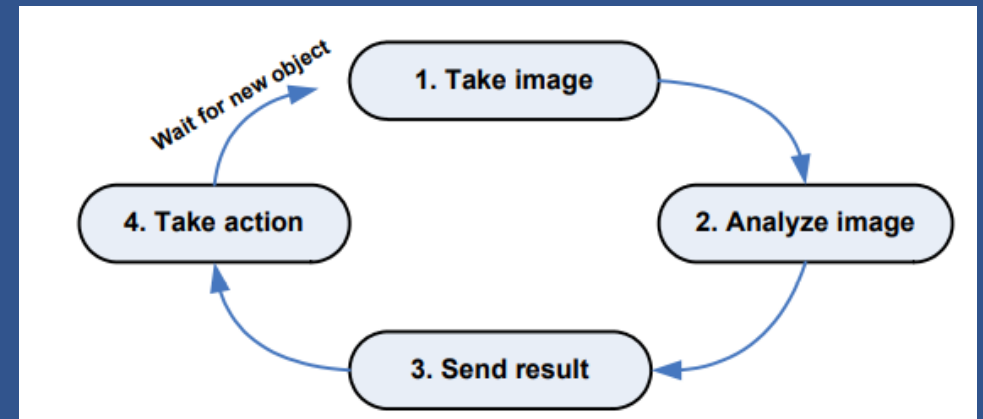


# Components of a machine vision system



# Components of a machine vision system

- Machine vision is the technology to replace or complement manual inspections and measurements with digital cameras and image processing. The technology is used in a variety of different industries to automate the production, increase production speed and yield, and to improve product quality.
- Machine vision in operation can be described by a four-step flow:
  - 1. Imaging: Take an image.
  - 2. Processing and analysis: Analyze the image to obtain a result.
  - 3. Communication: Send the result to the system in control of the process.
  - 4. Action: Take action depending on the vision system's result.



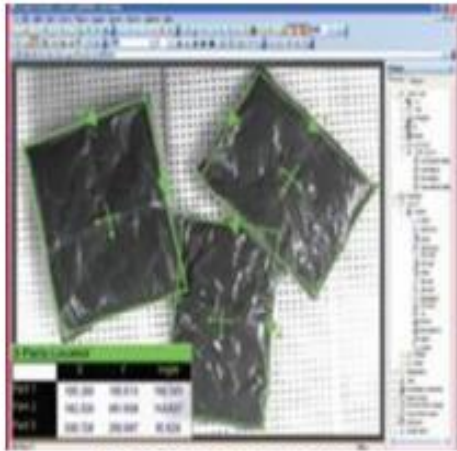
# Basic problem of vision: four approaches

- Guidance, Identification, Gauging, and Inspection (GIGI)  
OR
  - Locate, Inspect, Measure, Identify
- <https://www.euresys.com/en/Products/Machine-Vision-Software/Open-eVision-Libraries>

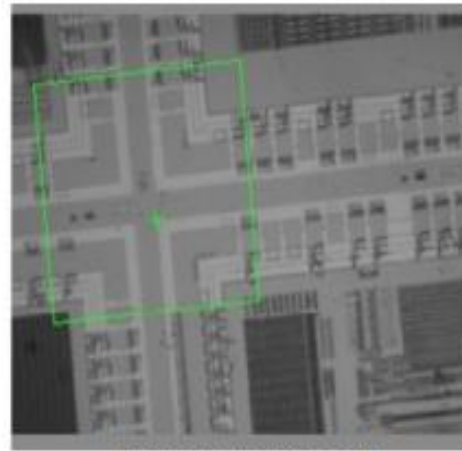


# Basic problem of vision: four approaches

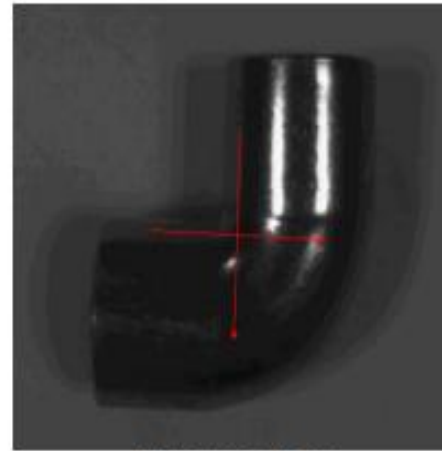
- Locate or Guidance



Tomato sauce packets



Printed circuit board



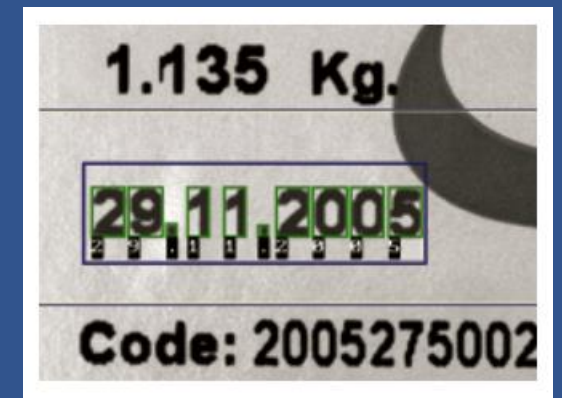
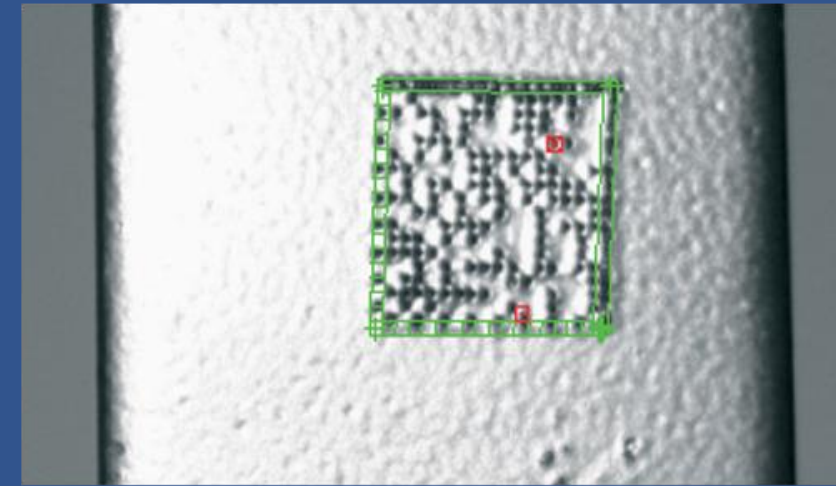
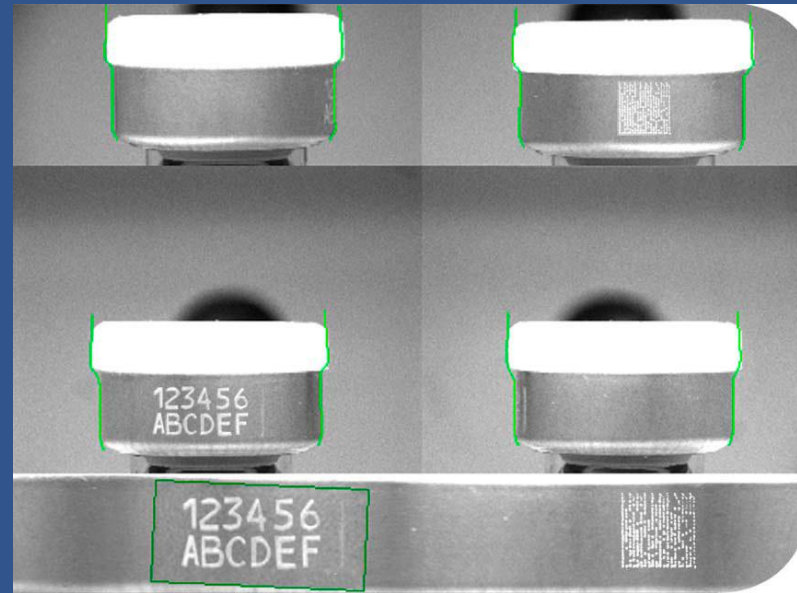
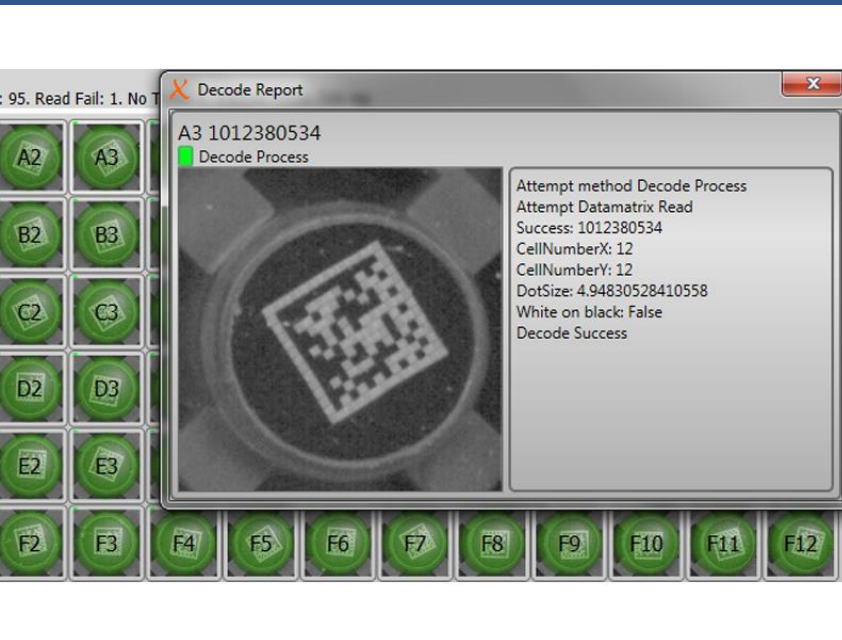
90 degree elbow





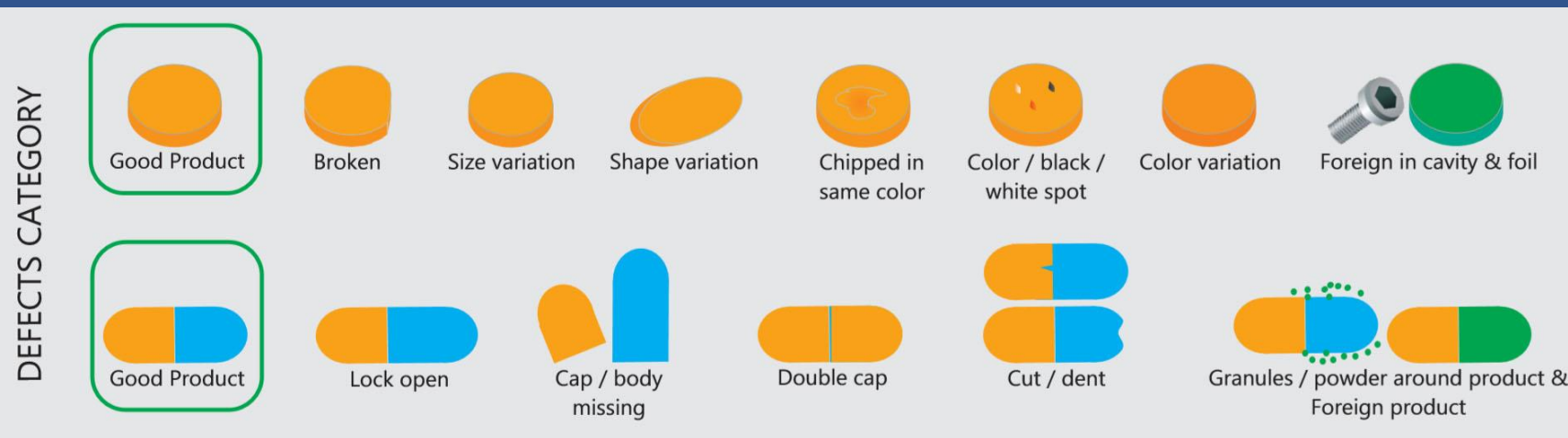
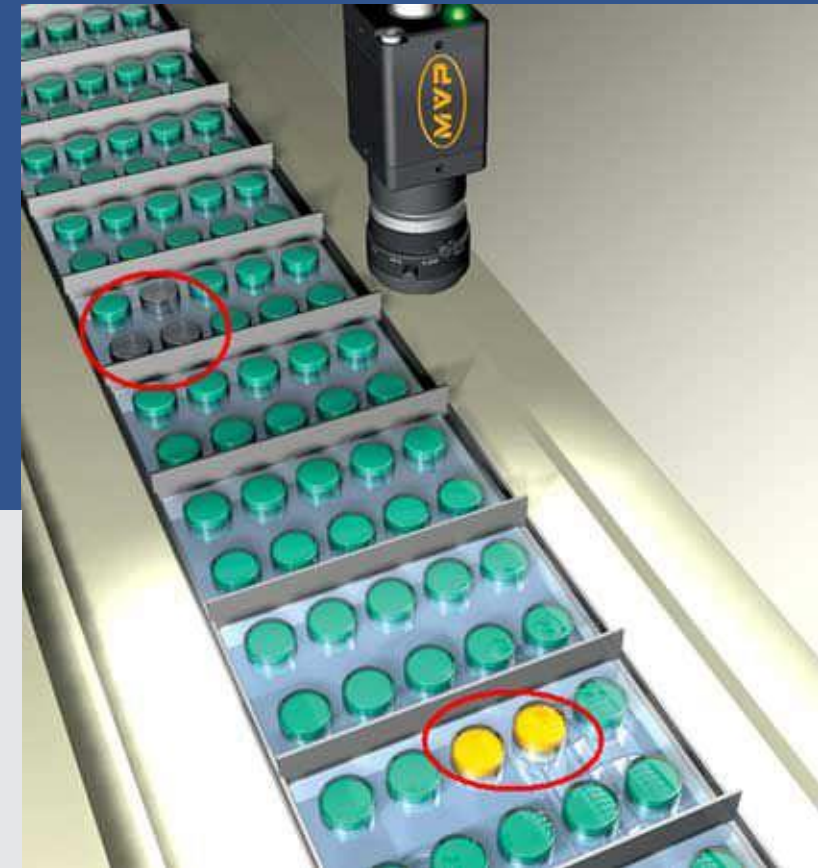
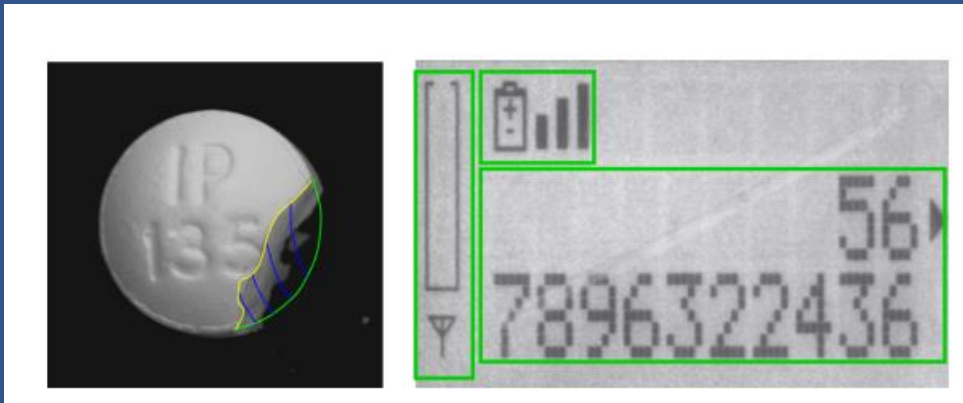
# Basic problem of vision: four approaches

- Identify



# Basic problem of vision: four approaches

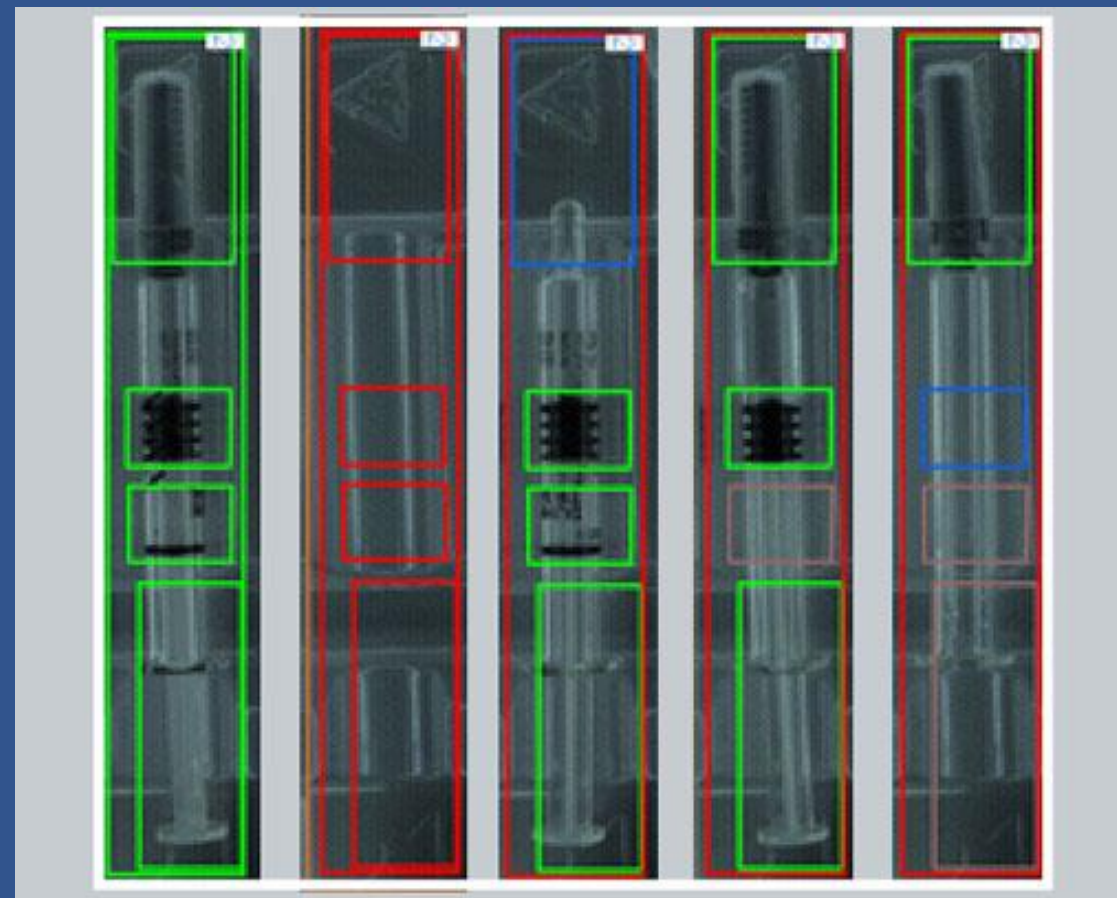
- Inspection





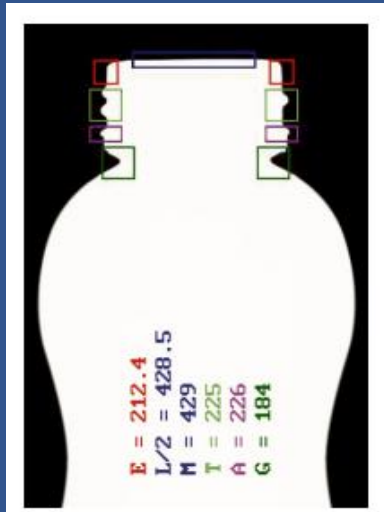
# Basic problem of vision: four approaches

- Inspection



# Basic problem of vision: four approaches

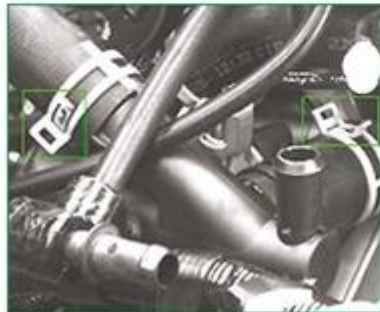
- Measurement



Can opener verification



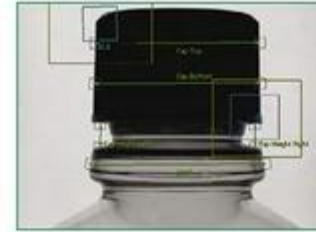
Checking the type and quantity of water aerators



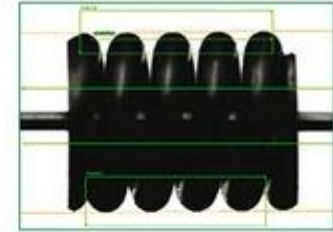
Hose clip verification



Fastener presence verification



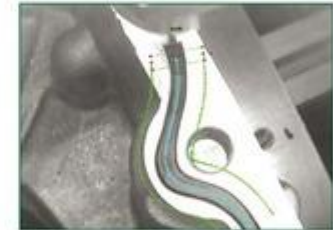
Various different measurements



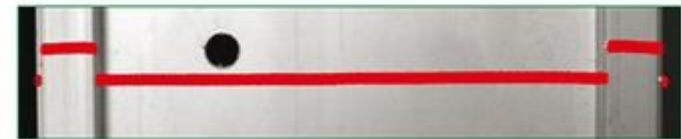
Spring measurement



A component being measured for accurate hole geometry



Sealant being inspected on an engine assembly



A laser can be used to deliver accurate 3D measurements as is shown above