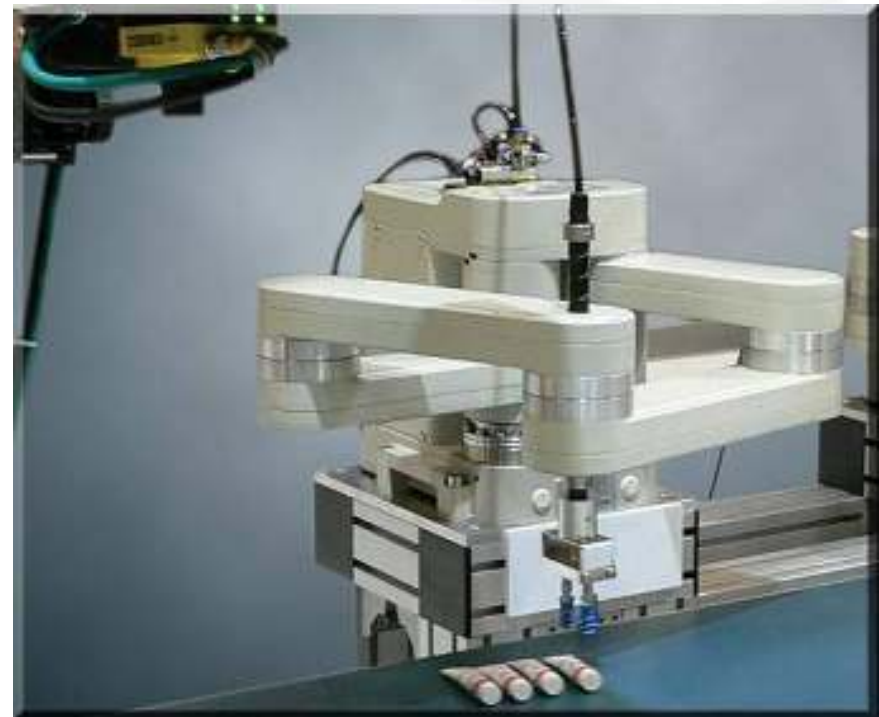


# Robotics



How Machine Vision is used to meet today's increased demands for information, quality, and manufacturing flexibility in robotic applications



# Proven Applications for Robotics



## Robotic Guiding

- Palletizing & Depalletizing
- Locate unfixtured parts
  - Conveyor Tracking
  - Component Assembly
- Machine Tending

## Robot Control

- Sorts & decides which part to pick up among many
- Inspects parts before picking up
- Improves robot functionality and “intelligence”

## Industry Range

- Automotive & Aerospace
- Medical Devices
- Consumer Goods Packaging
- Electronics

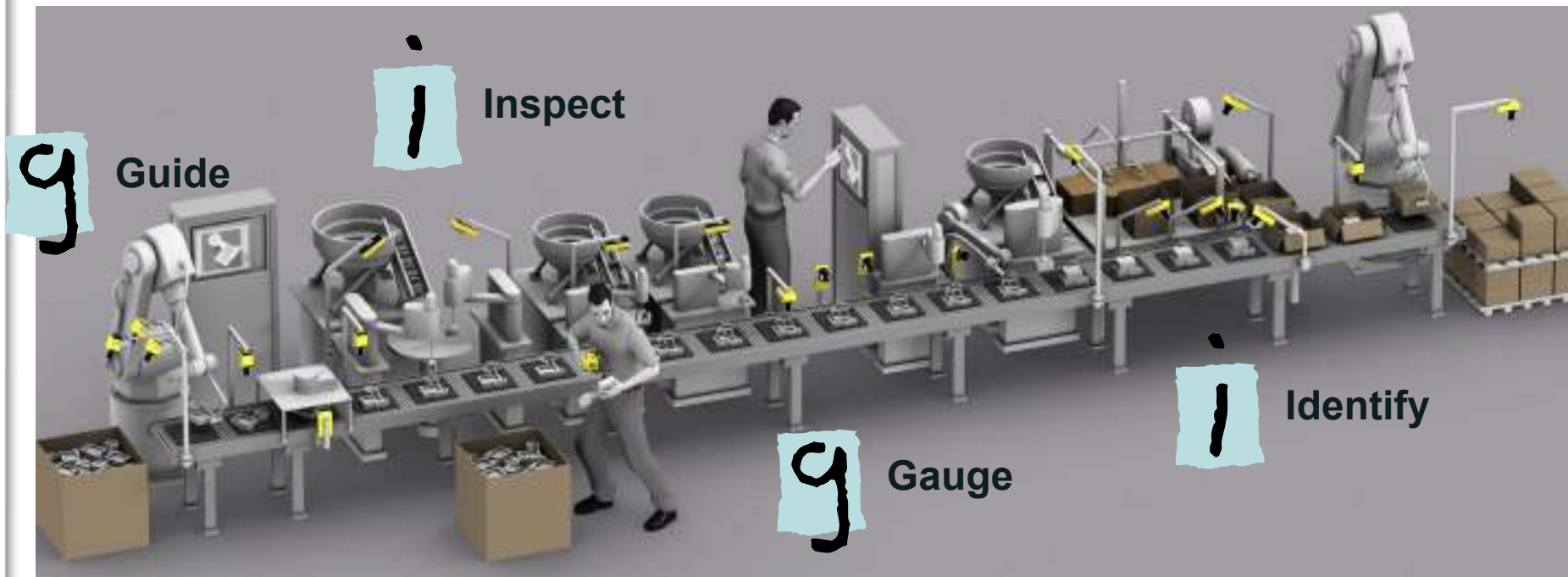
- Benefits of Machine Vision:
  - Increase Productivity
  - Lower Capital Equipment Costs

# Vision Applications



What does machine vision do?

g i g i



# Applications for Vision Guided Robotics



- Palletizing/Depalletizing
  - Placing/Removing parts to/from pallets
- Conveyor Tracking
  - Locate unfixtured parts on conveyer and place them in package
- Component Assembly
  - Locate unfixtured part and assemble to other components
- Machine Tending
  - Locate unfixtured parts on conveyer and place into CNC work cells
- Robotic Inspection
  - Use robot to manipulate part or camera to inspect critical features of part



# Automotive De-Palletizing



- Application:
  - Stacked pallets of automotive wheels are placed at machining center
  - Robot needs to locate part and place in CNC mill for milling operation
- Benefit:
  - Allows flexibility to locate various wheel types
  - Vision provides precise wheel location to eliminate costly custom fixturing

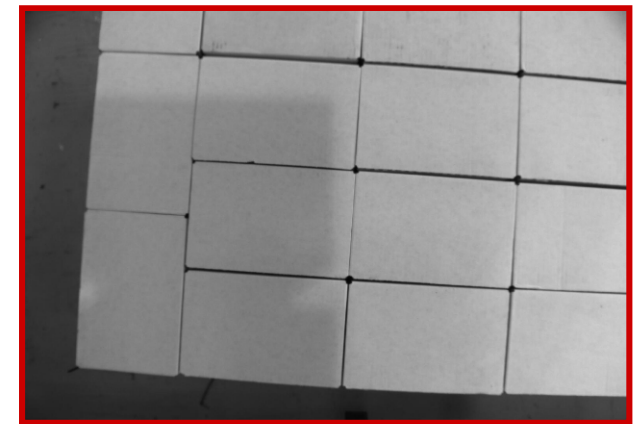
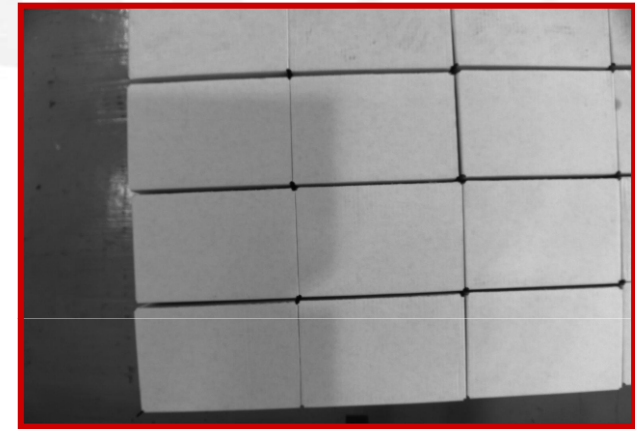


# Food Package De-Palletizing



## g Guide

- Application:
  - Stacked pallets of juice boxes need to be de-palletized for distribution
- Benefits:
  - Allows for flexible part location process to support various juice box sizes and configurations
  - Provides exact location despite product movement on pallet

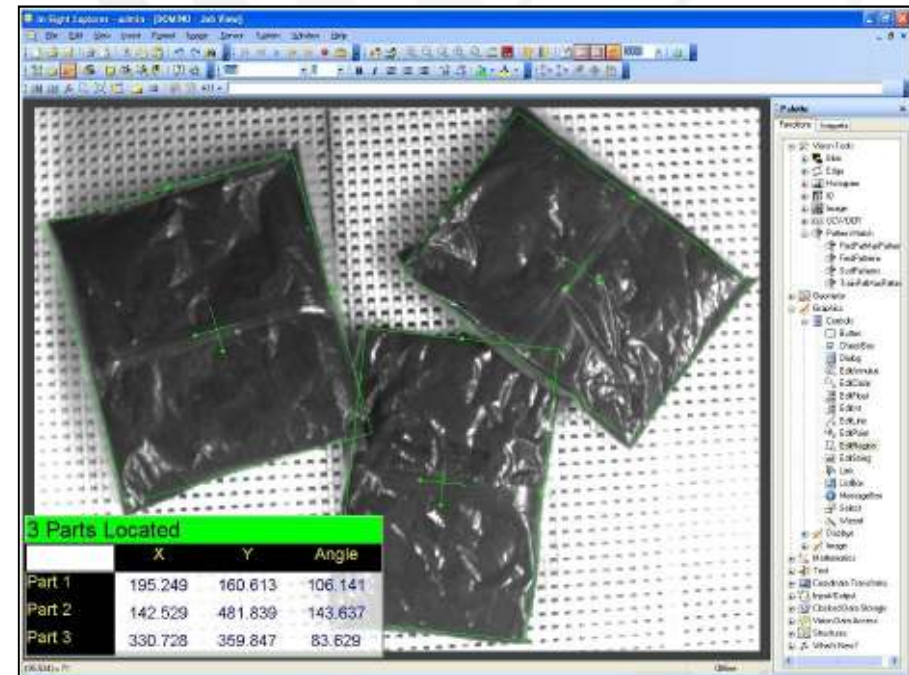


# Conveyer Tracking of Packaged Food



- Application:

- Tomato Sauce packets need to be located on conveyer and placed into boxes for shipment
- Difficult to locate because:
  - Patterned background
  - Non-uniform lighting
  - Overlapping parts
  - Specular reflection from bags



- Benefit:

- Packets vary in size and can sometimes overlap
- flexible solution provides exact location



# Pharmaceutical Conveyor Tracking



- Application Description
  - Pharmaceutical product tubes need to be located on conveyer and placed into package for distribution
- Customer Need
  - Tubes are loosely placed on conveyer – need vision to provide exact location
  - Tubes vary in size – need flexible solution to accommodate a range of product sizes



# Automotive Component Assembly

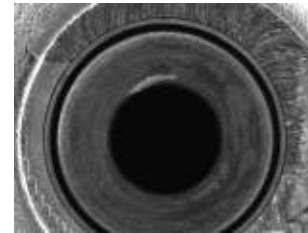


- Application Description
  - Locate holes and assemble Rivnuts into automotive frame

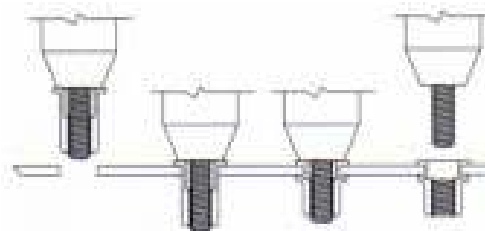


Rivnut

- Customer Need
  - Part is not precision-fixtured – need vision to locate part
  - Need .003" accuracy to insure proper assembly of pin into hole
  - 27 different hole locations on 5 different planes



Hole



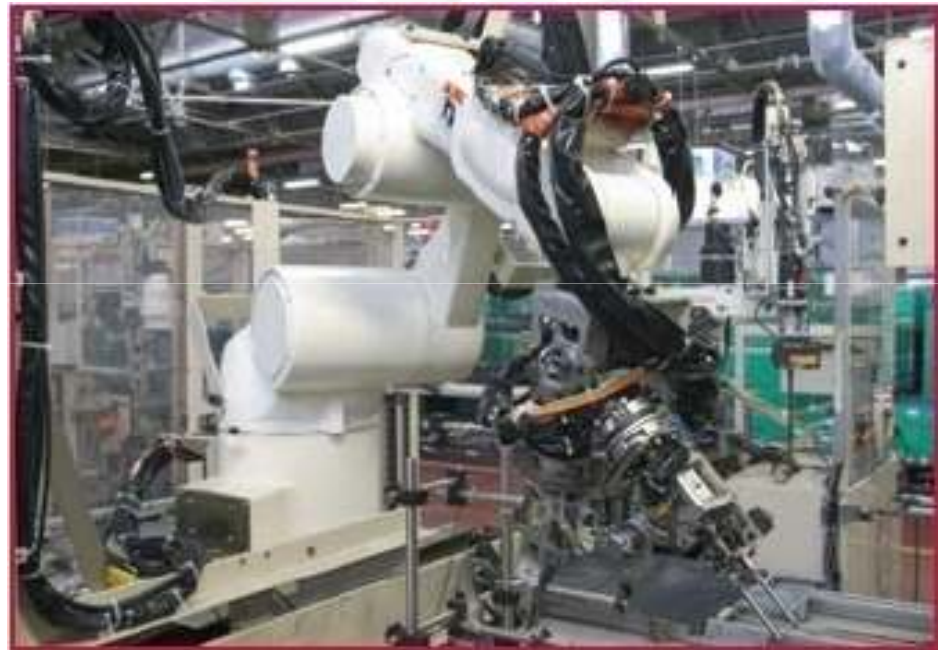
Assembly Cross-Section



# Electronics Component Assembly



- Application Description
  - Inserts need to be loaded into an injection mold housing
- Customer Need
  - Need flexible solution to accommodate a wide range of parts



# Robotic Inspection of Electronic Components



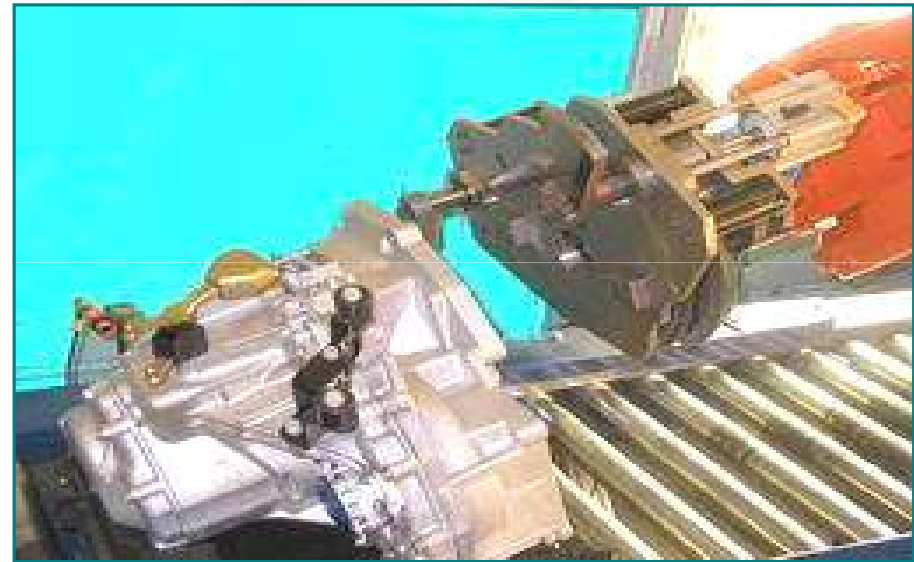
- Application Example
  - Consumer electronics stereo components are assembled in a flexible automation cell
- Customer Need
  - Verify that the correct components are being assembled



# Robotic Inspection



- Application Description
  - Inspection process supporting multiple product types in small lot-size production
  - Need to achieve 70 inspections in under 1 minute
- Customer Need
  - VGR provides flexibility in being able to inspect multiple parts



# Machine Tending



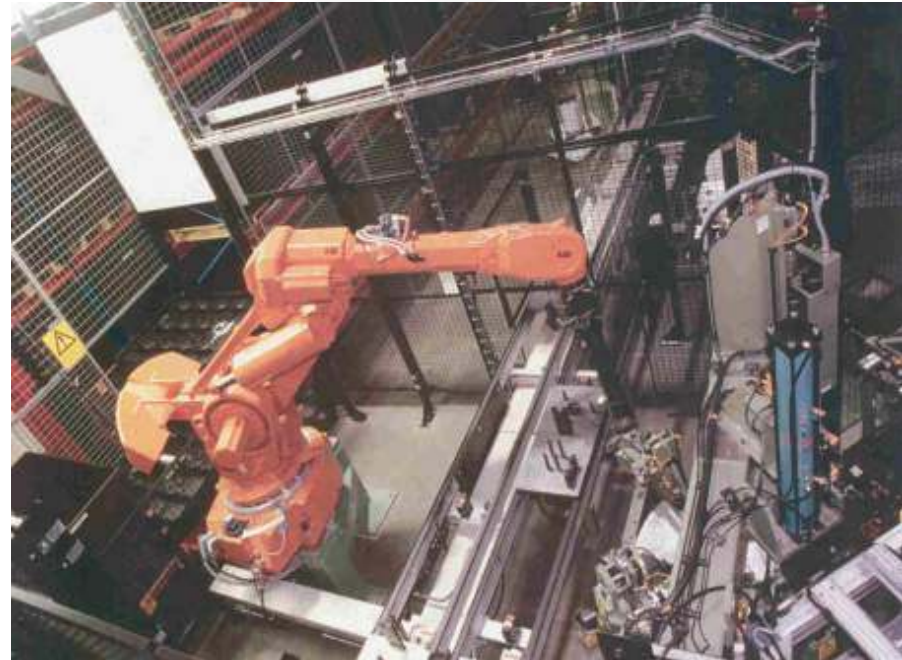
- Application Description
  - Robot locates parts on conveyer and places them into machine press
- Customer Need
  - Parts are in random orientation on conveyer – need flexible system to locate parts



# Front Wheel Assembly



- Locate & Guide
  - Locate the front wheel assembly
  - Provide X, Y, and  $\Theta$  to Robot for guidance



# Instrument Panel Position



- Verification of instrument panel style and position
  - 7 different panels
  - Each must be positioned to a tolerance of 1/8"
  - Cycle time is 8 seconds



## Handling of Digital Thermometers



- Guide robot to retrieve thermometers
  - Vision Sensor finds each thermometer as it moves down the conveyor belt
  - Positional coordinates are communicated to a robot controller
  - Must handle inconsistent lighting



# Suspension Coil Lifters



- Locating suspension coil lifters for robotic handling
  - Parts fed from a hopper onto a conveyor
  - Move freely down line at random orientations
  - Unfinished parts appear bright or dull depending on light angle
  - Vision sensor locates parts and sends positional coordinates to pick-and-place robot



## Benefits of Machine Vision:



- Increase Productivity
- Trace Parts
- Boost Yields
- Enhance Product Quality
- Lower Capital Costs
- Reduce Scrap & Rework
- Increase Customer Satisfaction
- Improve Brand Image