Use of Vision in Robotic Packaging Lines

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Packaging
Vision in Robotic Packaging

- Robot Guidance for Packaging
  - Location of parts, containers, skids, etc.
- Part Verification
  - Pattern match, Bar Codes
- Part Inspection
  - Presence, Quality, Labels
- Process Control
  - Fill Levels, etc.

Who Uses Vision in Packaging?

<table>
<thead>
<tr>
<th>Automotive Parts</th>
<th>Semiconductor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics</td>
<td>Plastics</td>
</tr>
<tr>
<td>Food and Beverage</td>
<td>Pharmaceutical,</td>
</tr>
<tr>
<td>Consumer Goods</td>
<td>Medical</td>
</tr>
</tbody>
</table>
Benefits of Flexible Vision Based Automation

- Improved quality and reliability
- Increased productivity
- Stronger competitive position
- Increased flexibility
- Decreased time to market
- Safety and potential cost of disability claims
- Savings on scrap and rework
- Reduced direct labor costs and related expenses
- Advancement of technology

Robots & Vision vs. People

<table>
<thead>
<tr>
<th>ACTION</th>
<th>MACHINE</th>
<th>PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>Extremely Fast</td>
<td>Medium</td>
</tr>
<tr>
<td>Accuracy</td>
<td>High</td>
<td>Varies</td>
</tr>
<tr>
<td>Repeatability</td>
<td>High</td>
<td>Varies</td>
</tr>
<tr>
<td>Interpretation</td>
<td>Fixed</td>
<td>Highly</td>
</tr>
</tbody>
</table>
Manipulator Types

- SCARA
- Six Axis
- Cartesian
- Platen

Connectivity

- Dedicated I/O
- AB Remote I/O
- DeviceNet
  - Master or Slave
- Profibus
- CC Link
- Serial interface
- Ethernet
- Connectivity to PLC’s and PC’s
Vision Systems

- Vision Unit
- Single or Multiple Cameras
- Lens Selection
- Camera Mounts
- Application Software
- Calibration Target
- Lighting of Field of View
- Communications to Outside World

Robotic Vision
Robotic Vision Process Types

- **Fixed Camera Vision**
  - Single Camera
    - Speed
  - Multiple Cameras
    - Speed
  - Concurrent Processing of images

Robotic Vision Process Types

- **Robot Mounted Vision**
  - Single FOV - Tight access/multiple parts/clearance
  - Multiple FOV - low cycle time requirements
## Basic Vision Types

- PC Based System with Frame Grabber Board
- Smart Sensor Based Vision System

## Camera Features

- Modular System
- Self Contained Sensor
- Std Camera
- Ring Light Integrated With Vision
- Tiny Size
Choosing a Lens

- Required Field of View
  - Size of Inspection Area
- Lens to Object Distance
  - Clearance for camera
- Depth of Field
  - Window of focus
- Resolution
  - Sensing Accuracy

Camera Enclosures

- Protection of the camera in severe environments.
  - Dust
  - Moisture
- Flap Cover
- Air Curtain
## Lighting

<table>
<thead>
<tr>
<th>Light Panels</th>
<th>FL Ring Light</th>
<th>FL Linear Light Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot Light</td>
<td>Dark Field</td>
<td>LED Ring Light</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dual FL Ring Light</td>
</tr>
</tbody>
</table>

## Choosing A Vision System

- Identify the Application
- Determine the Potential for Success
- Understand the Application
- Know What the Vendors can Do
- Solicit Complete Proposals
- Define System Acceptance
- Partner with a Reliable Supplier
1D and 2D Bar Codes Verification

- 1D and 2D Bar Codes
  - Product Identification
  - Data Base Reporting
  - Product Tracking

1D Vision Scan
2D Vision Scan

Part Count Verification

Inspection of containers for presence of product
Part Location

Part Finding Demo
Robot Accuracy and Repeatability

- **Accuracy** and **Repeatability** is available from 20 microns to inches.

- **Accuracy**
  - The ability to move an exact distance or angle with the resulting move corresponding to real world measurement values

- **Repeatability**
  - The ability of the robot to move along a path and to the same position as taught by the operator.

- Note: Accuracy and repeatability are NOT the same thing.

Vision & Convey Tracking

<table>
<thead>
<tr>
<th>System Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCD camera</td>
</tr>
<tr>
<td>Vision Sensor Unit</td>
</tr>
<tr>
<td>Monitor</td>
</tr>
<tr>
<td>Image Processing Interface Board</td>
</tr>
<tr>
<td>Light Source</td>
</tr>
<tr>
<td>Light Stand</td>
</tr>
<tr>
<td>Encoder</td>
</tr>
<tr>
<td>Case for Vision Sensor and Monitor (Drip proof construction equivalent to IP54)</td>
</tr>
</tbody>
</table>

Notes:
- The other components are same as those for vacuum type package.
- Piece-by-piece gripping tool is used.
Vision and Conveyor Tracking Demo

Conveyor Tracking with Robot Mounted Vision
Image Processing

Proprietary

Spreadsheet

Packaging Application Review

Data Tracking and Packaging of Medical Vials
Vial Storage and Packaging Cell

- **System Requirements**
  - Act as an order-processing tool for drug vials.
  - Accept incoming drug vials presented in racks, store the tubes.
  - Manage inventory, and process orders for vials.
  - Vertical form, fill and seal automation.
  - Sales order is imprinted on the pouch.
  - Receive order-processing instructions from customer’s host business system.
  - Orders are processed on a first-come-first-served basis.
  - 12,000 tubes per 12-hour shift.

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Major Cell Components

- Sample rack management through a flexible tray system
- Vial inventory staging deck capable of storing 5,232 tubes.
- Dual tube-handling robots with multi-tube grip capability. (Linear Platen Technology)
- Vertical form, fill, and seal packaging automation.
- Barcode reading technology (2D) for collecting and verifying vial ID and order processing accuracy. (Cognex)
- Integrated MS/SQL Server database for collecting sales order information and other reporting functions.
**Mini Robot Module**

- 2 Axis Robot Module
- 4 Z Axis Modules
  - Permits Single Pick Operation

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**Bar Code Vision Station**

- Cognex 4000 Vision Sensor
- Field of View for 2 Vials per Scan
4 Vial Gripper and Bar Code Vision Station

- Storage for 4,251 tubes
- 10mm Dia. Tubes
- 16mm x 16mm Spacing
- Position recording in Master Database

Work Storage Deck
Vertical Form Fill and Seal

- Air Tube Delivery
- Stainless Steel Funnel
- 55 CPM Max.
- Integrated Printer for Sales Information
- Cut Off Knives
- Hermetically sealed

Vial Storage and Packaging System
Choosing the Right Robot!

- Controller
  - Command Set, Hardware Options, Connectivity
- Manipulator
  - Type, Reach, Payload, Speed, Family of Products
- Accessories
  - Grippers, Valves, Interface, Conveyors, etc.
- Ease of use and integration
- Documentation
- Service and Support
- Training

Vision Systems

- Connectivity makes it possible to integrate to standard vision solutions, such as:
  - Matrox
  - Omron
  - DVT
  - Cognex
  - RVS

- These systems are typically integrated through Ethernet or Serial connections. Some robots have bus mounted proprietary vision systems.
Why Use Vision?

- Cost reduction
- Accuracy
- To find randomly placed parts
- To verify part type
- To inspect part
- Affordable
- Maintainable

Questions?

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