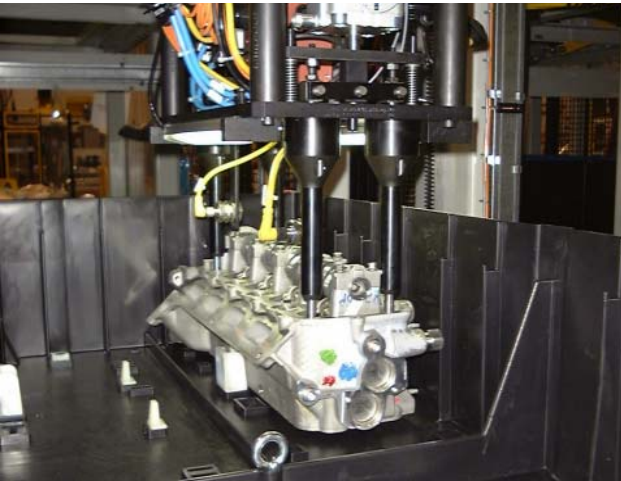


Engine Head Decking Using SC3D™

The robot must pick up engine heads that are stacked in 4 layers of plastic dunnage at 8 heads per layer.



Braintech's unique Single Camera 3D™* (SC3D) technology uses a single CCD camera to guide the robot to transfer and position the engine head on the engine block.

*Patent pending

Problem

A major automaker needs to assemble V8/V10 engine heads onto V-configuration engine blocks. This operation, referred to as "engine head decking", is to be performed using a robot and specialized end-effector. The engine heads arrive at this station inside 4'X4'X4' plastic bins. The heads are placed on 4 layers of plastic dunnage¹ at 8 heads per layer. The robot is to intercept the head, grasp and transport it to the location of the engine block and accurately place it over the mating surface of the engine block. This mating has to take place with an accuracy and repeatability of $\pm 0.20\text{mm}$. Engine heads arrive on plastic dunnage and are stacked in multiple layers inside the bins. As a result their 3D position and orientation is unknown to the robotic arm and can vary by as much as $\pm 30\text{mm}$ in x, y and z as well as by up to ± 7 degrees in tilt angles. Since robots traditionally operate blindly and play back memorized paths, the robot has no way of knowing how to intercept the heads for grasping and therefore, will crash into the parts. Past attempts with use of 2D vision systems have failed to solve the problem due to tilting of parts in 3-dimensional space.

¹ Dunnage refers to plastic containers that serve to separate the individual parts and layers of parts in bins of automotive powertrain parts.

Solution

A single CCD camera is housed in a compact enclosure and integrated into the robotic gripper. Compact hi-frequency fluorescent lighting is also added to the end-effector to properly illuminate the parts. Before each pick-and-place cycle, the robot positions the camera over the bin containing the engine heads. The vision guidance system captures a single image and performs its analysis. The end result is the 3D coordinates of the part, i.e., position (x, y, z) and orientation (roll, pitch and yaw angles). These values are transmitted to the ABB robot controller via Ethernet. At this point the robot controller uses the information to adjust the pose of its end-effector to match the 3D coordinates of the engine-head seating position and proceeds to intercept and grasp the part out of the bin and then transfer and position it on the engine block. In extreme cases when the part is heavily tilted to one side, the vision guidance system can perform two measurements (coarse then fine) to achieve higher accuracy and reliability. This decision is made automatically by the vision guidance software running under eVF™.

System Summary:

- No. of Parts: 8
- Features per Part: 12 to 17
- Cycle Time per Part: 1.5s

MD-1007-2QD-A

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PathFinder VGR™

Vision Guided Robotic Solutions

Automotive

Powertrain

Parts Assembly

Multi Planar
Rigid Object

Technology

Science-SC3D

Single Camera Three Dimensional is a revolutionary technology exclusively developed by Braintech for determining the 3D coordinates of rigid multi-planar parts from a single video image. Braintech originally developed SC3D in response to demand from a major auto-maker for a robust 3D robot guidance system for automotive part-handling applications. Based on the use of a single conventional CCD video camera, Braintech's SC3D technology is ideally suited for robotic applications requiring exact knowledge of the work piece's 3D coordinates.

Software-eVF

eVisionFactory™ (eVF) is a component-based, integrated environment based on open standards developed by Braintech vision professionals for building and implementing robust and highly-supported VGR solutions.

Unlike other General Purpose Machine Vision tools, eVF is designed from the ground up to suit the needs and challenges of VGR. Starting with its flexible organization of every VGR project, its easily configurable tools and components, advanced robotic vision technology and online, network-enabled support, eVF paves the way for development of sophisticated and expandable VGR solutions at the manufacturing level. In short, eVF is organized to deliver:

- e - Real-time Internet Support
- v - Vision Science and Engineering
- f - Application Development and Operation

Working closely with ABB Global Engineering Solutions, Brampton, Ontario, we made ABB robots "Vision Ready." This includes creating robot communication and guidance components as part of eVF.

Benefits

- Vision guidance of robots enables Adaptive Automation; the robot can deal with three-dimensional real-world variations in the position of parts and avoid costly crashes and damaged parts
 - Direct labor and injury costs are reduced while quality and productivity increases
 - eVisionFactory solution environment provides unprecedented flexibility & configurability to meet application's unique needs
 - eVisionFactory's common intuitive user interface makes technical training transferable from one solution to the next
 - Solution uses off-the-shelf standard hardware; this reduces initial cost and complexity while increasing reliability and maintainability
 - Integrated real-time Internet support
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Specifications

- ABB IRB 6400 Robot
- Robot End-effector
- Conventional CCD Sony Camera
- High-Frequency Electronic Ballast Fluorescent Lighting
- Direct Ethernet Communication to Robot
- Pentium III 1000 Mhz
- 256 Mb RAM
- Matrox Meteor II Standard Framegrabber
- eVF
- Win 2000

Featuring ABB
Vision Ready Robots
Powered by
eVF

