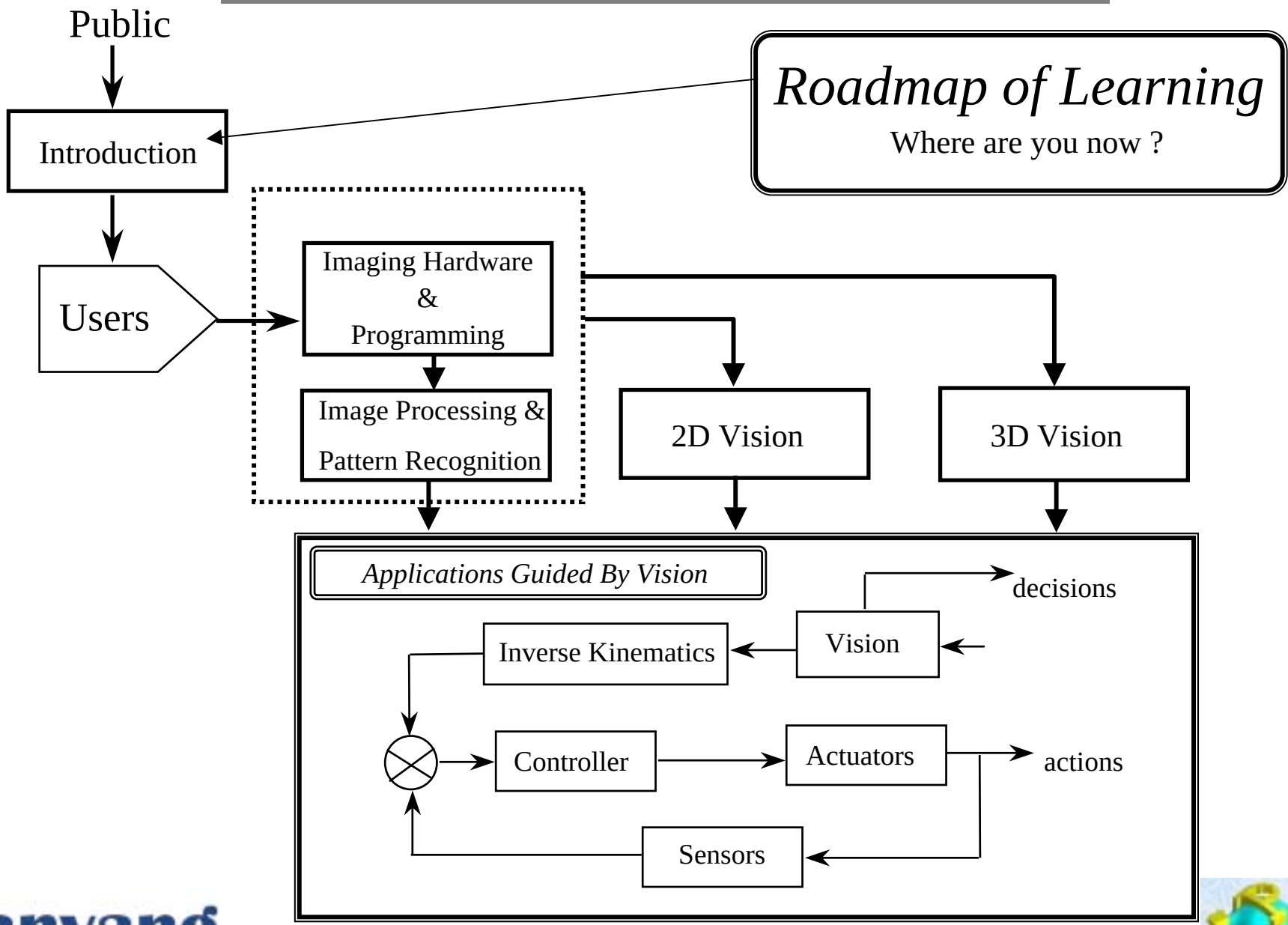

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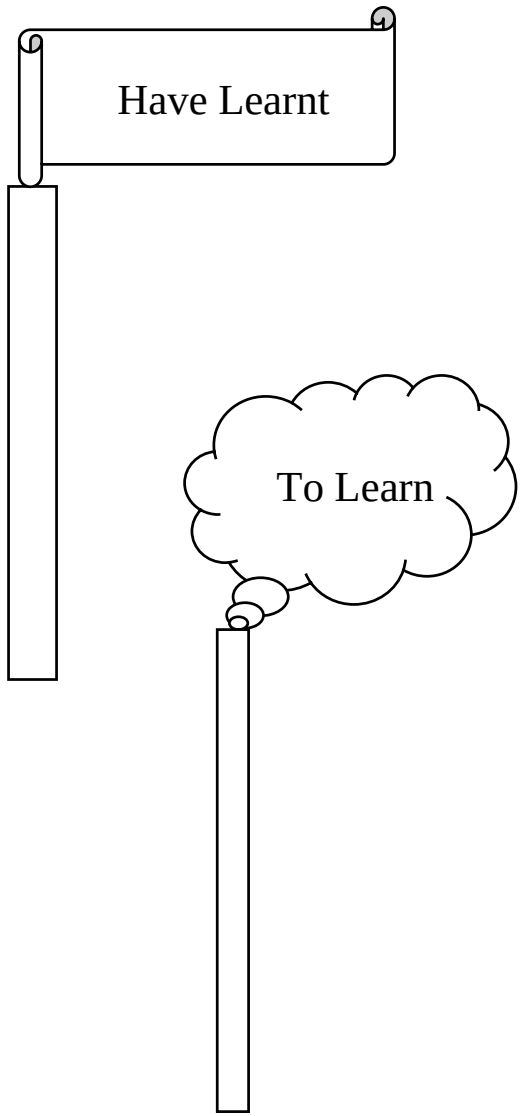


Chapter 1: Introduction to Machine Vision

1.1 Overview

1.2 Vision System Configuration

1.3 Specific Problems with Machine Vision

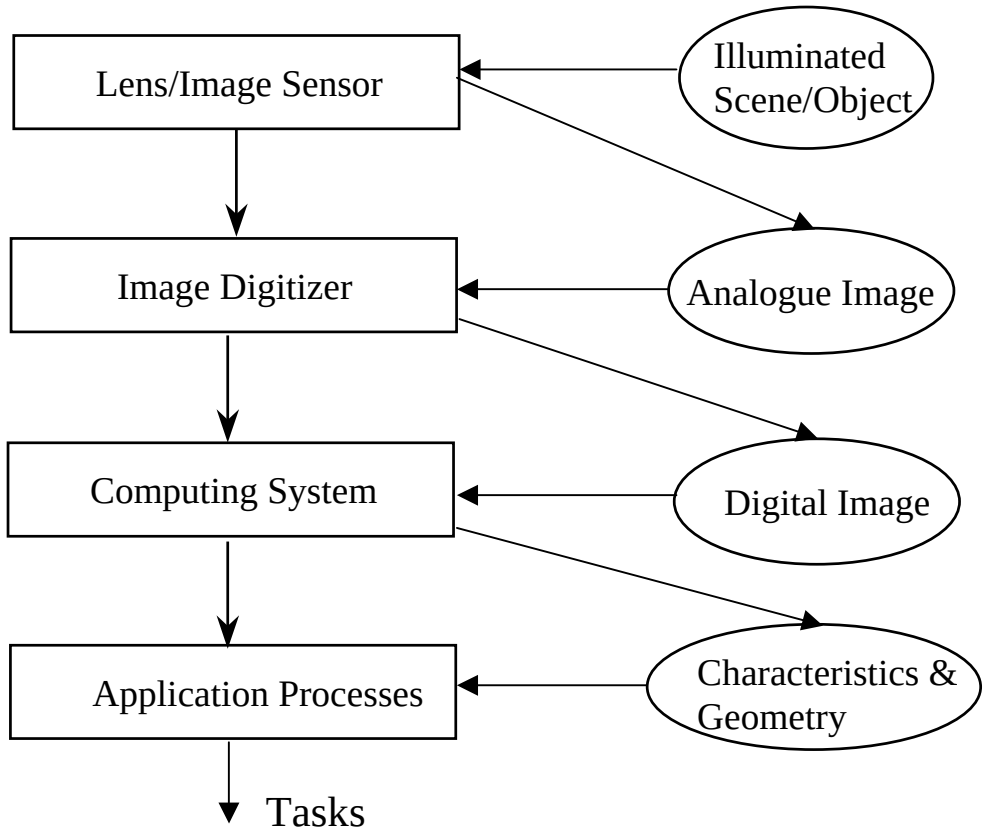
1.4 Lighting

1.5 Examples of Vision Application

- 1.5.1 Visual Guidance
- 1.5.2 Visual Inspection
- 1.5.3 Visual Measurement
- 1.5.4 Visual Identification

What is a machine vision system ? (A Review)

ANSWER:



What can be done with a machine vision system ?

ANSWER:

Visual Guidance:

To obtain a geometric (full or partial) description of a scene necessary to the safe planning and control of the movement of machine (eg, robot).

Visual Inspection:

To obtain photometric and/or geometric measurement of goods or parts or machined outputs (like printing) for the sake of ensuring the highest quality if possible.

Visual Measurement:

To obtain photometric and/or geometric measurement of machined outputs for different purposes (inspection, surveillance, etc)

Visual Identification:

To obtain metric features from images for the sake of identifying the belonging of objects under the viewing.

Visual Guidance

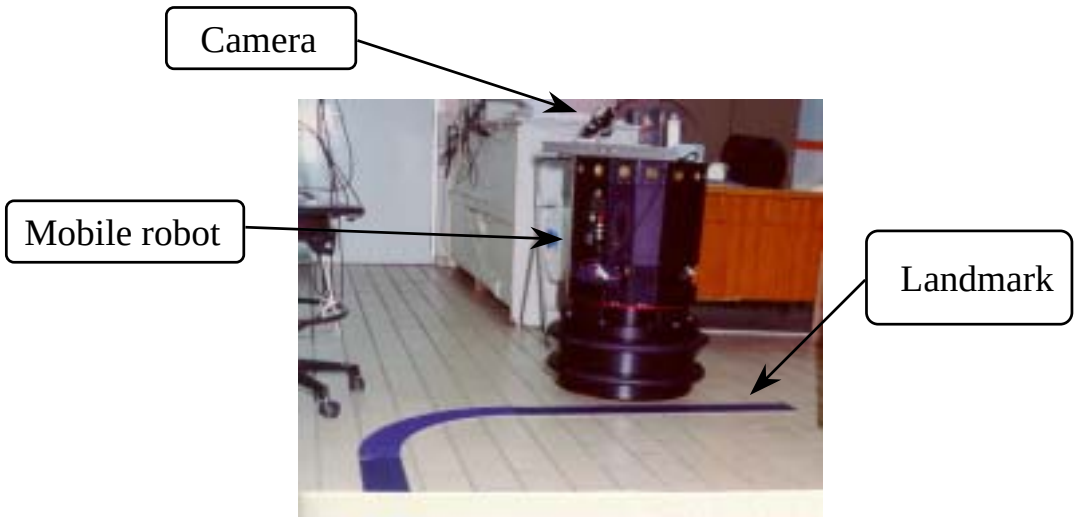
Example 1: Guidance of mobile robot/vehicle

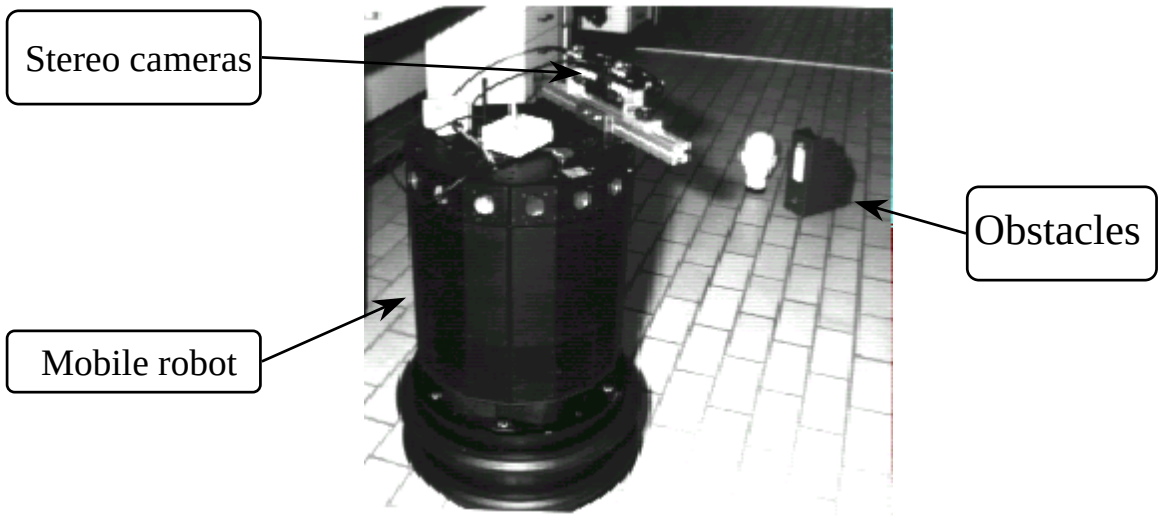
Requirement:

* detect landmarks

* detect free moving space

* detect obstacle





Visual Guidance

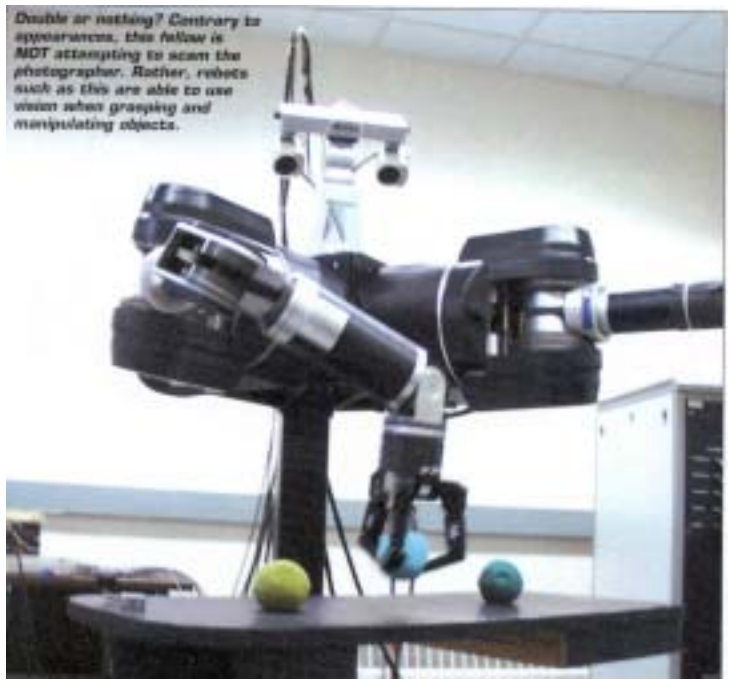
Example 2: Guidance of robot manipulator

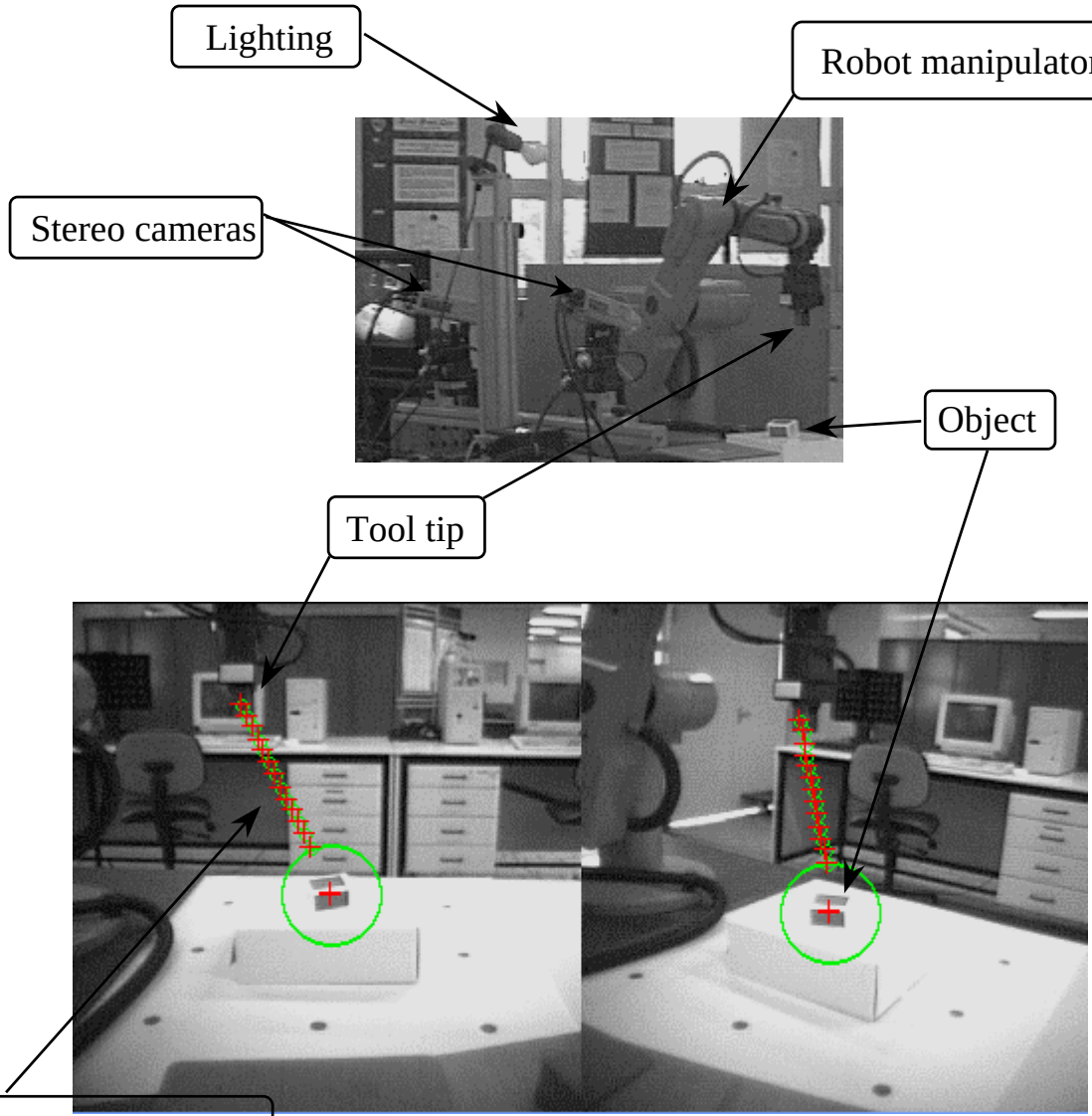
Requirement:

* detect where is the (moving) object.

* detect where is the robot's tool tip.

* compute tool tip's motion (position/orientation).





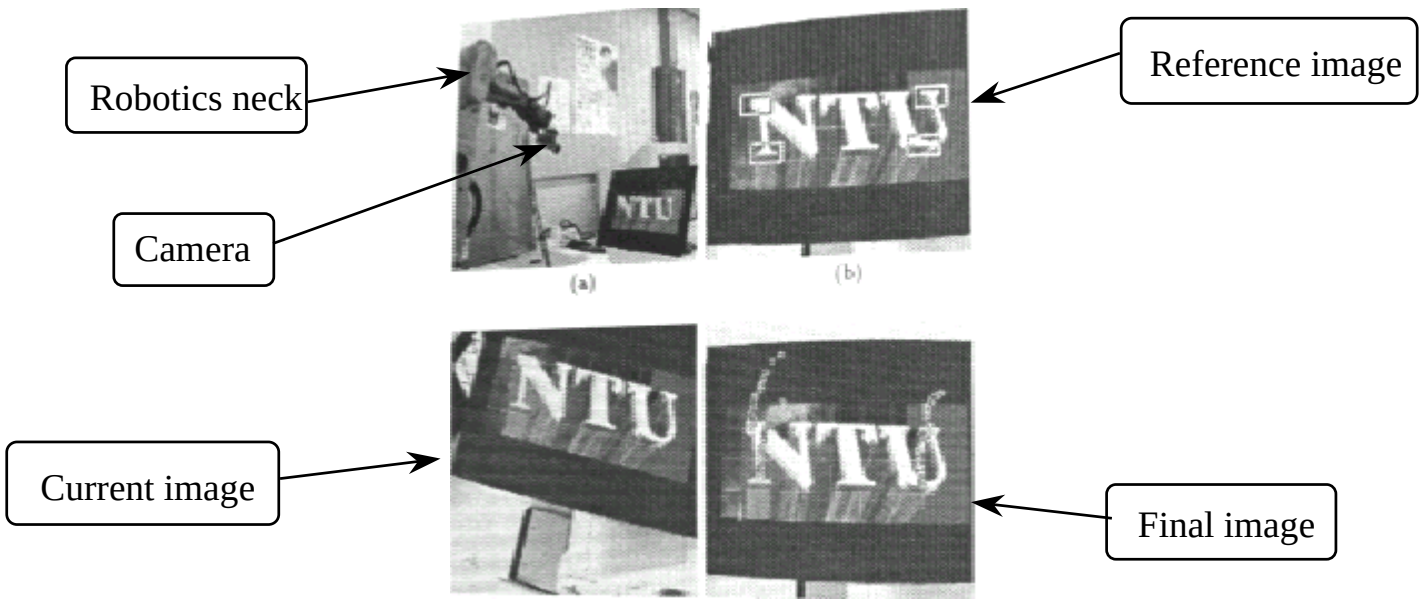
Stereo Images

Visual Guidance

Example 3: Guidance of robot's head

Requirement:

* store reference image of an object.
* detect the current image of the object.
* compute head's motion from image difference.



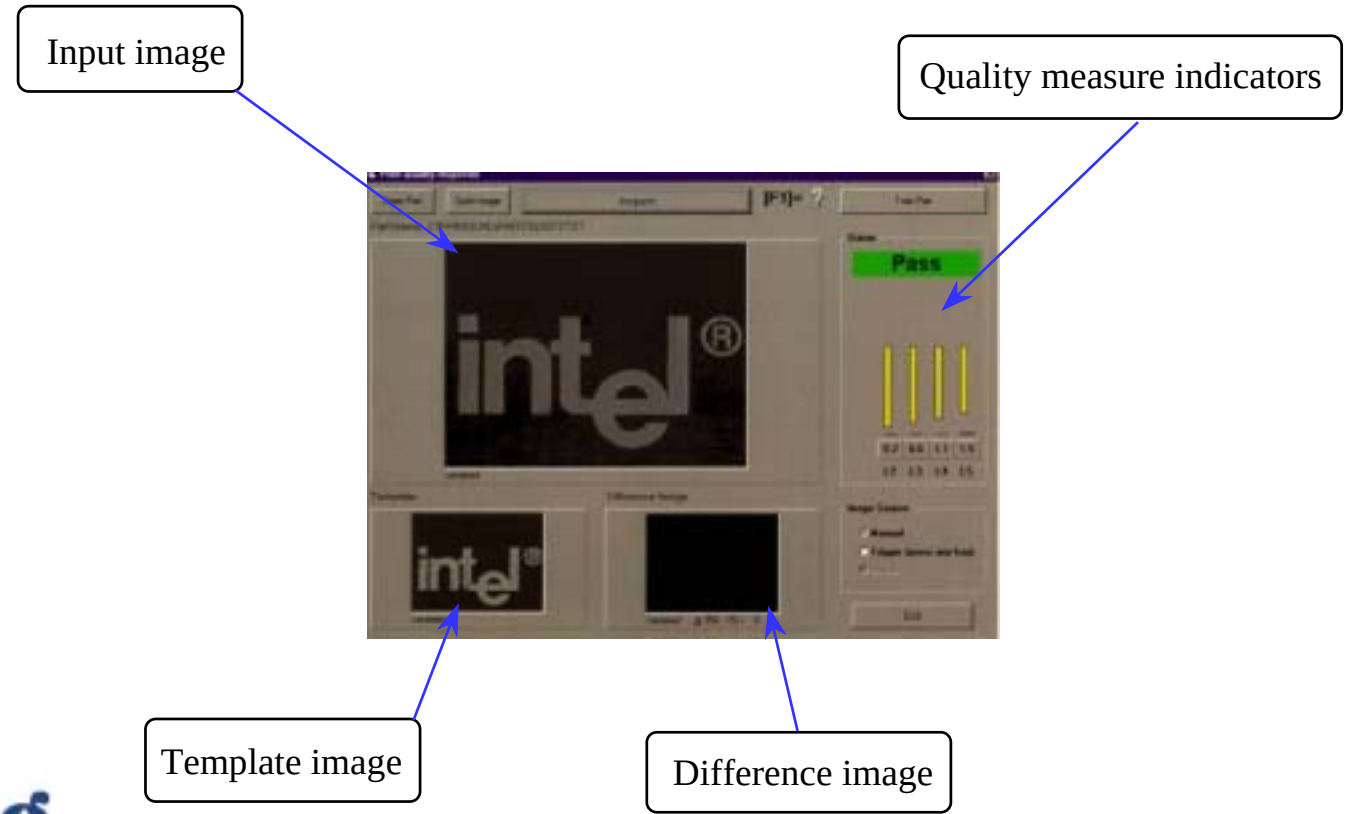
Visual Inspection

Example 1: Inspection of printing quality

Requirement:

* compare “template” with “image of print or logo”.

* detect defects.



Visual Inspection

Example 2: Inspection of packaging

Requirement:

* detect discrepancies in color.

* detect discrepancies in shape.

* detect discrepancies in dimension, etc.

Visual Inspection

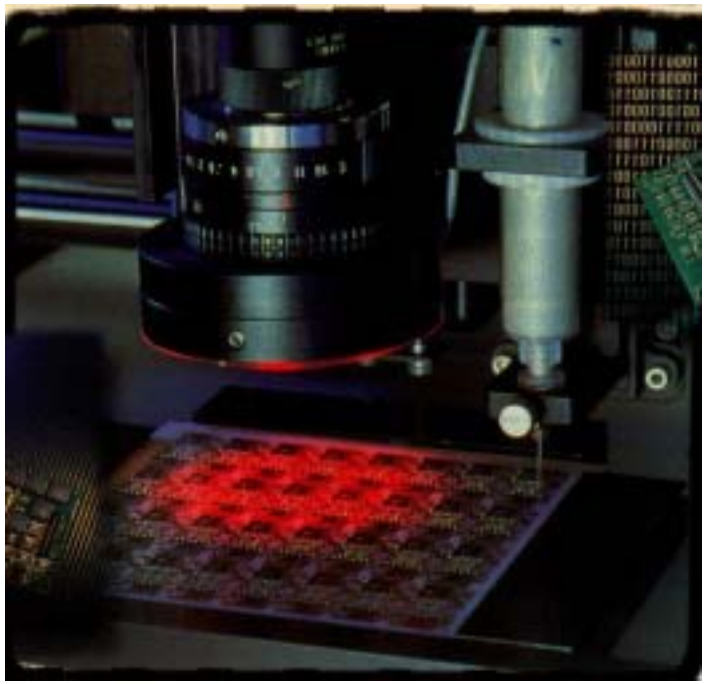
Example 3: Inspection of printed circuit board

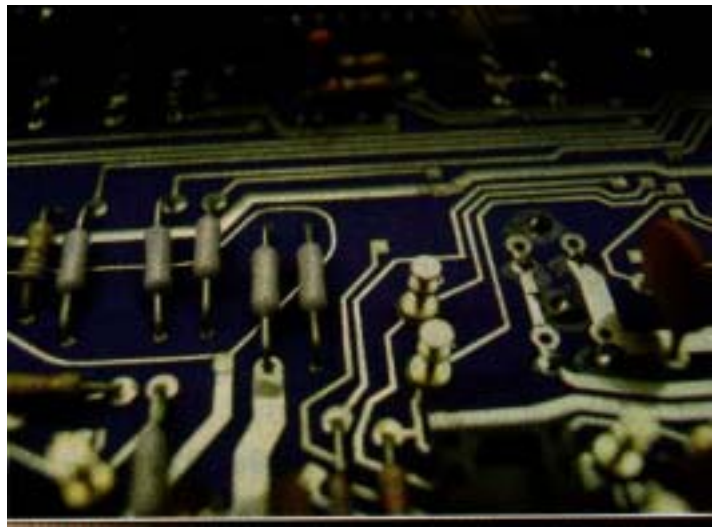
Requirement:

* detect missing components.

* detect broken connections.

* detect discrepancies in connections or components, etc.





Visual Inspection

Example 4: Inspection of printed characters or displays

Requirement:

* detect missing characters or display elements.

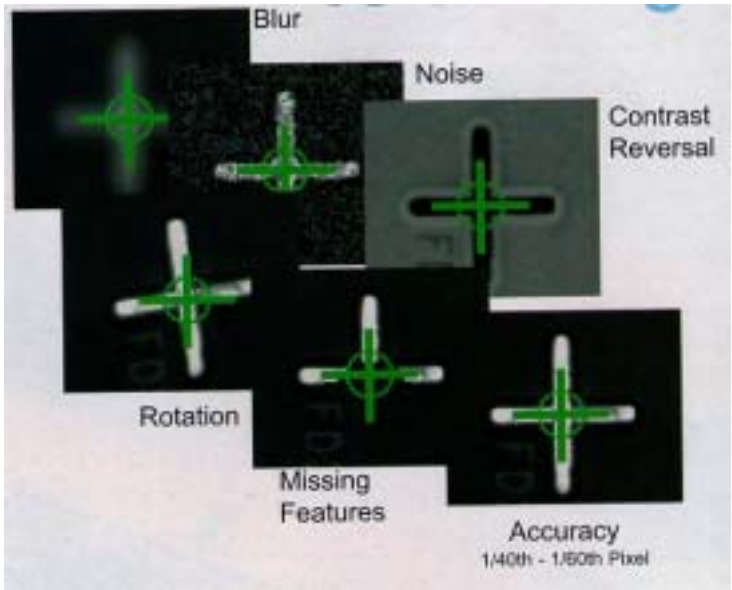
* detect discrepancies in the layout of characters or displays, etc.

Visual Inspection

Example 5: Inspection of parts

Requirement:

* detect sharpness.
* detect neatness.
* detect alignment.
* detect location.
* detect missing features, etc



Visual Inspection

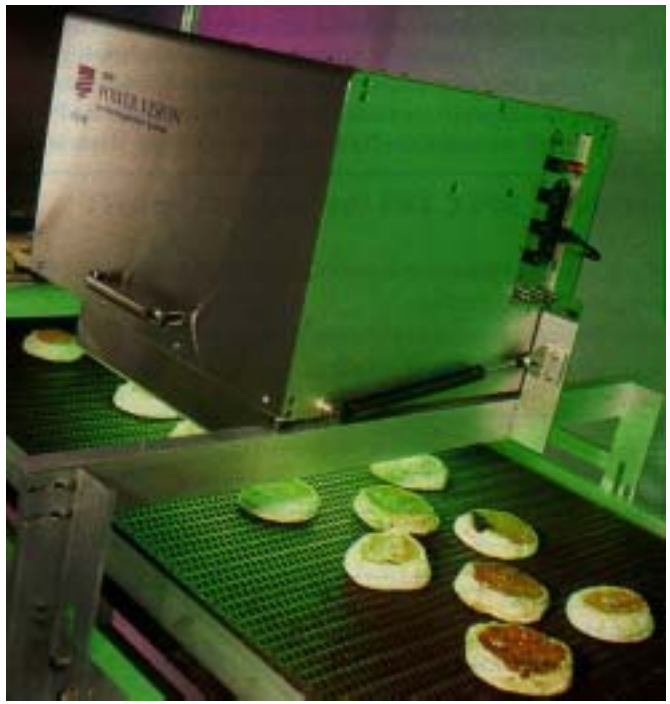
Example 6: Inspection of foods

Requirement:

* detect discrepancies in color.

* detect discrepancies in shape.

* detect discrepancies in dimension, etc.



Visual Inspection

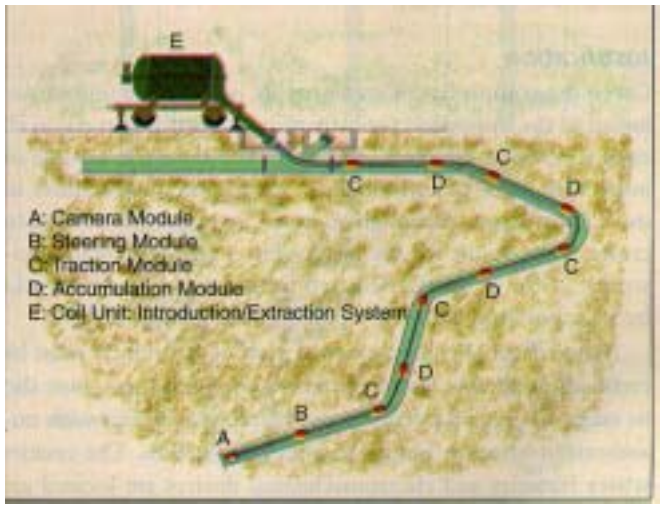
Example 7: Inspection of pipes

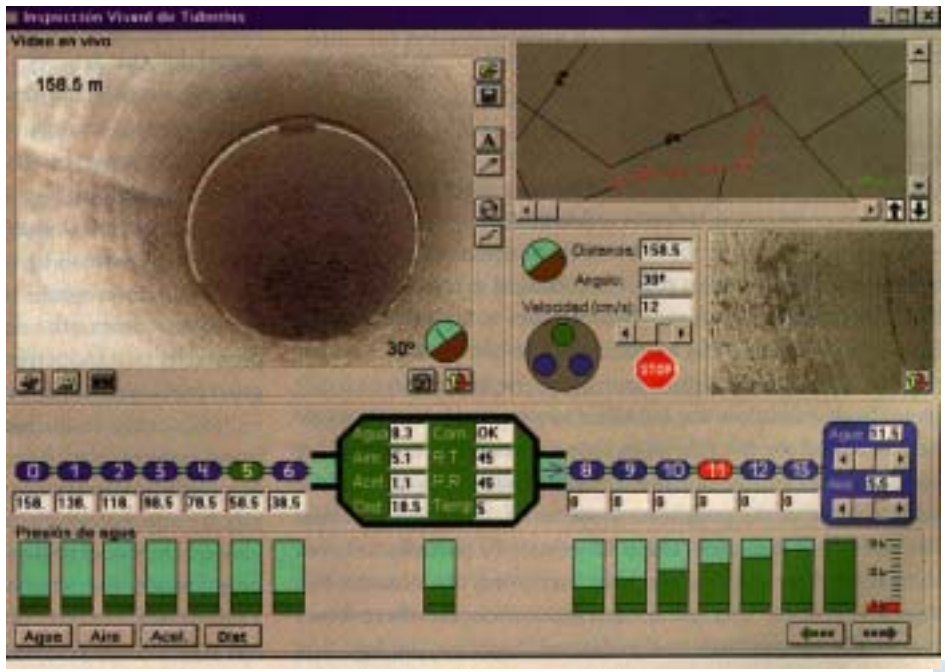
Requirement:

* detect discrepancies in shape.

* detect discrepancies in dimension.

* detect defects, etc.





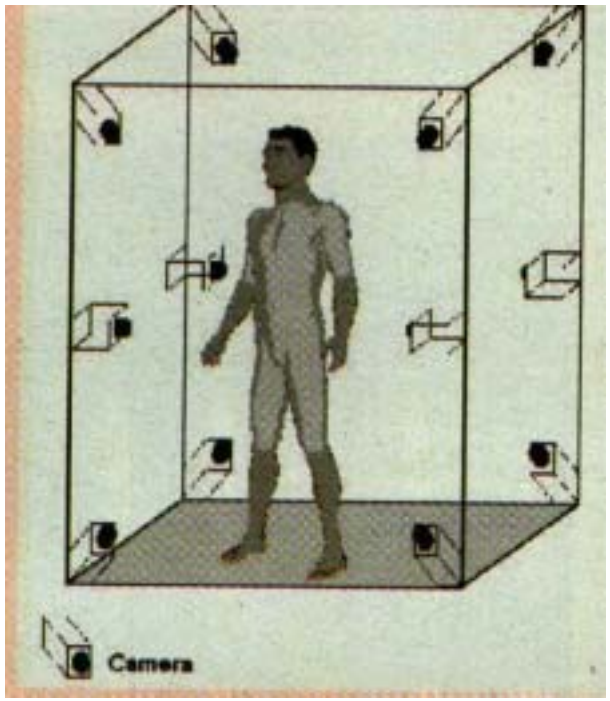
Visual Measurement

Example 1: Measurement of human body

Requirement:

* compute 3D coordinates of surface points.

* interpolate 3D points into surface patches, etc.



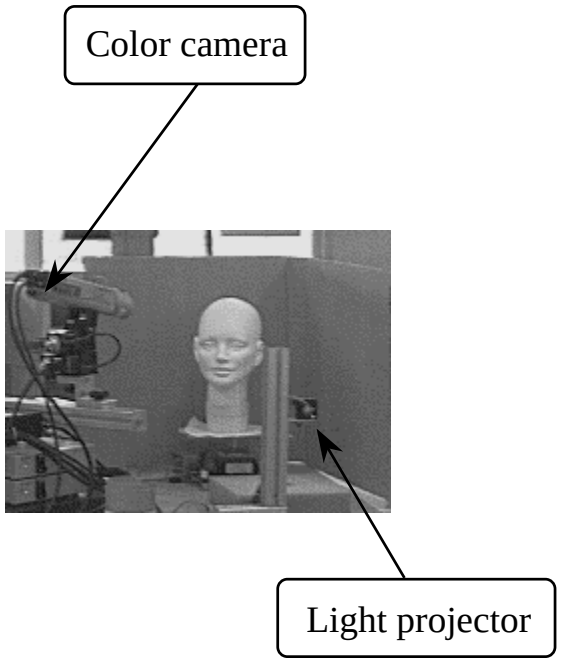
Visual Measurement

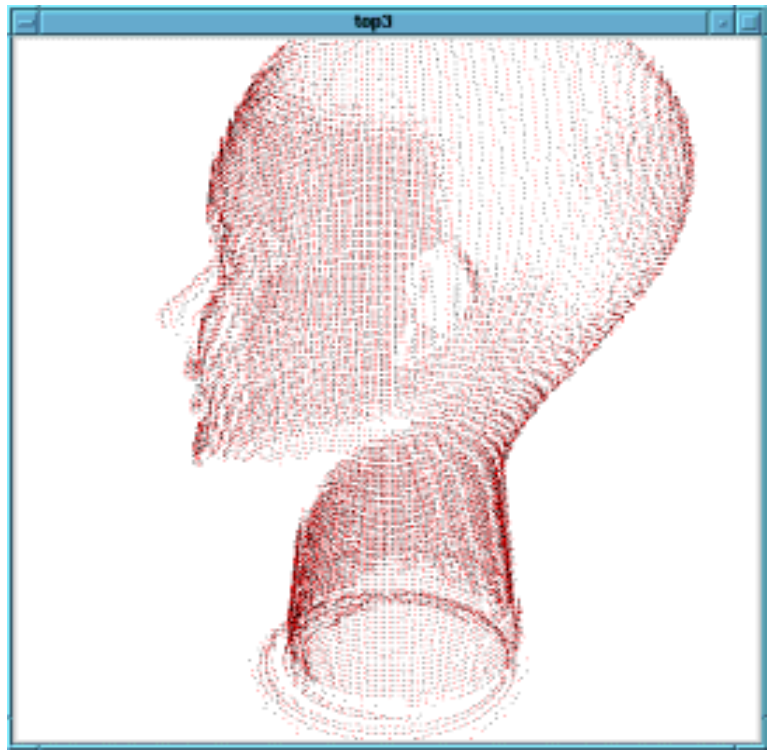
Example 2: Measurement of objects

Requirement:

* compute 3D coordinates of surface points.

* interpolate 3D points into surface patches, etc.



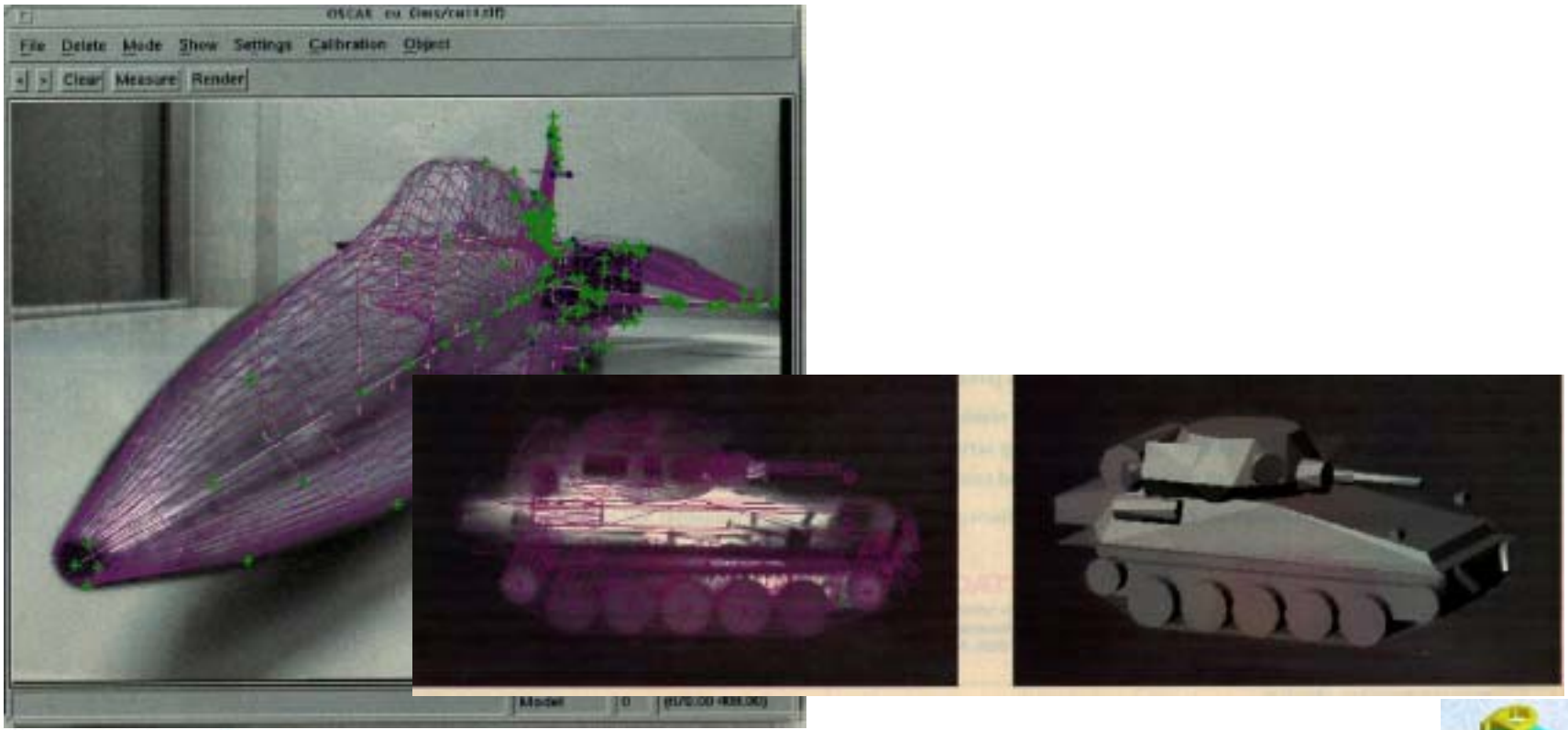


Visual Measurement

Example 3: Measurement of 3D CAD model

Requirement:

* match the projection of 3D CAD model with real images.

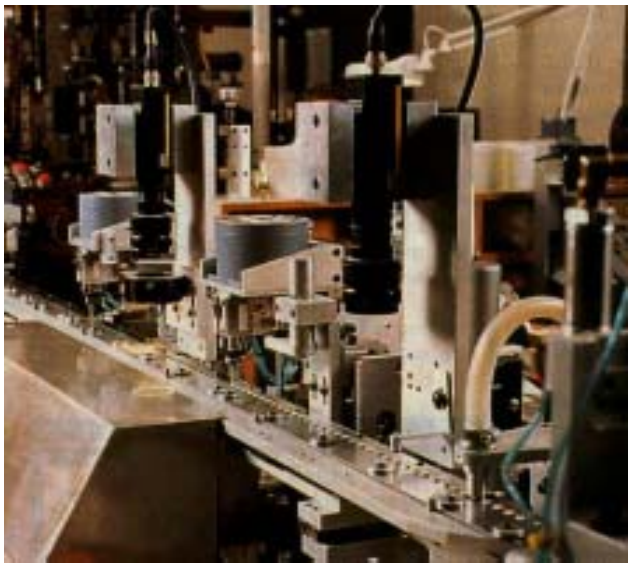


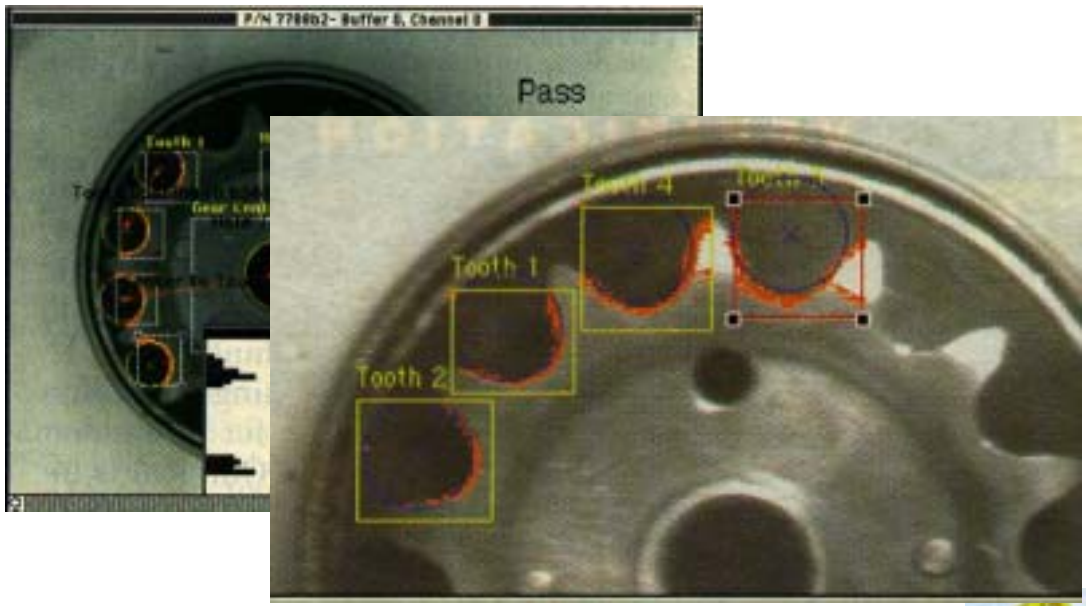
Visual Measurement

Example 4: Measurement of industrial parts

Requirement:

* compute locations.
* compute orientation.
* compute dimension.
* compute alignment, etc.



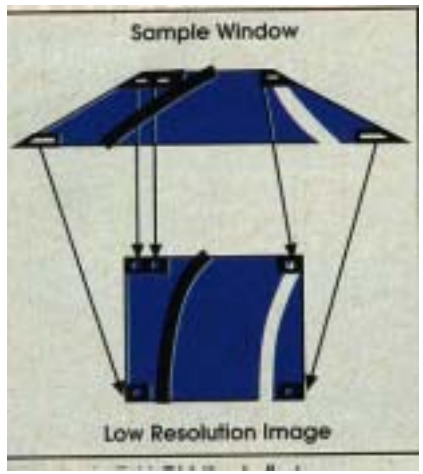


Visual Measurement

Example 5: Measurement of roads

Requirement:

* compute geometry, etc.



Visual Identification

Example 1: Identification of human identity

Requirement:

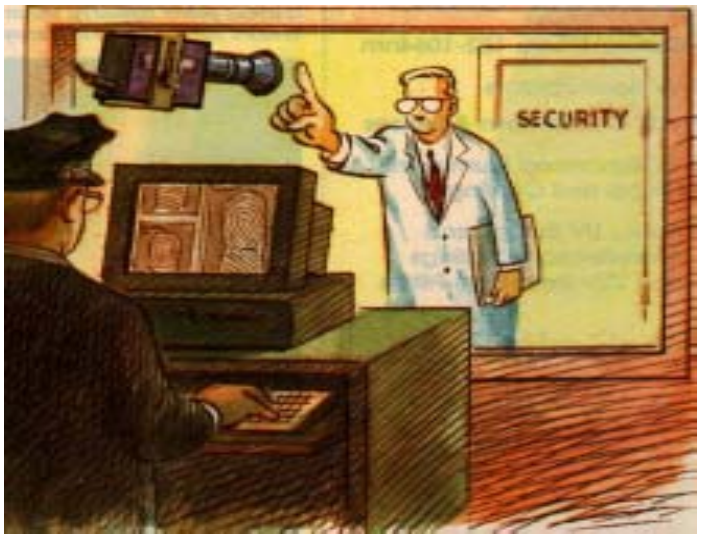
* compute face-related features.

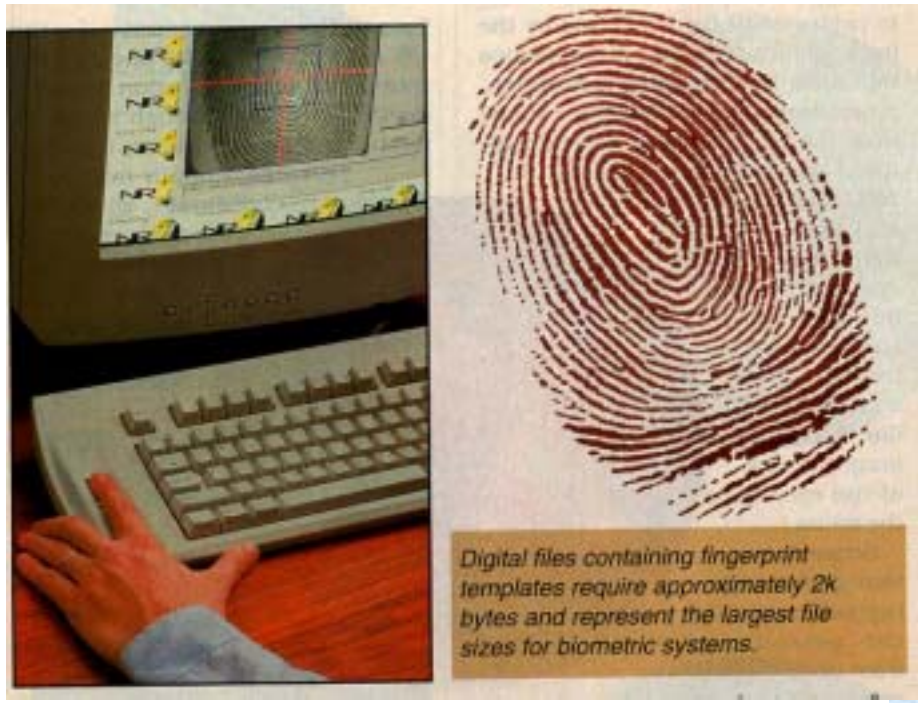
Visual Identification

Example 2: Identification of human identity

Requirement:

* compute finger-print-related features.





Visual Identification

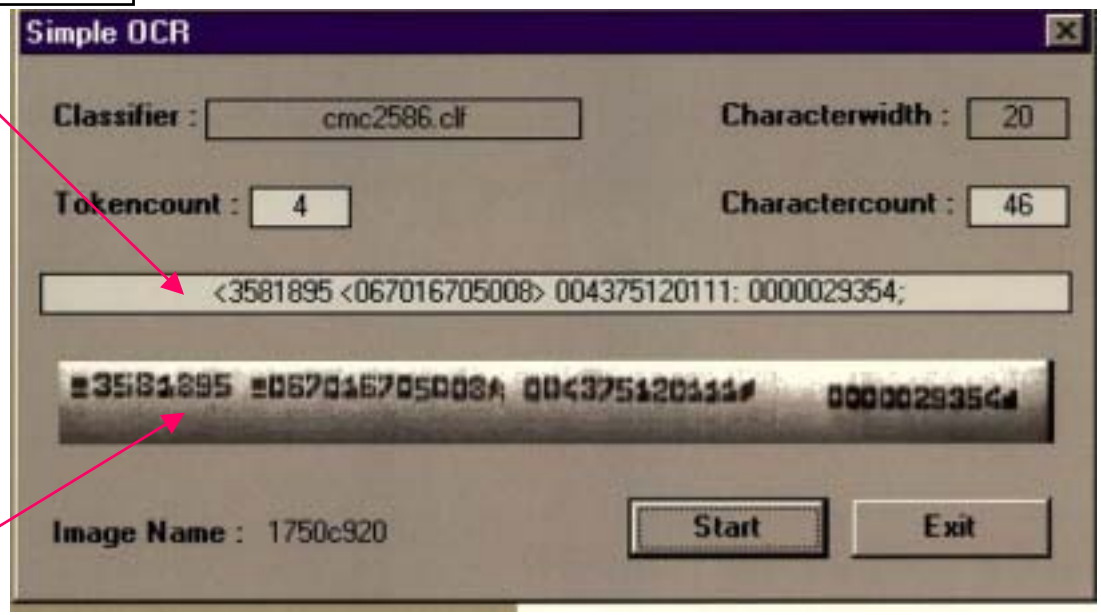
Example 3: Identification of printed characters or license number

Requirement:

* detect printed characters.

* classify printed characters, etc.

Output of Identification



Input Image

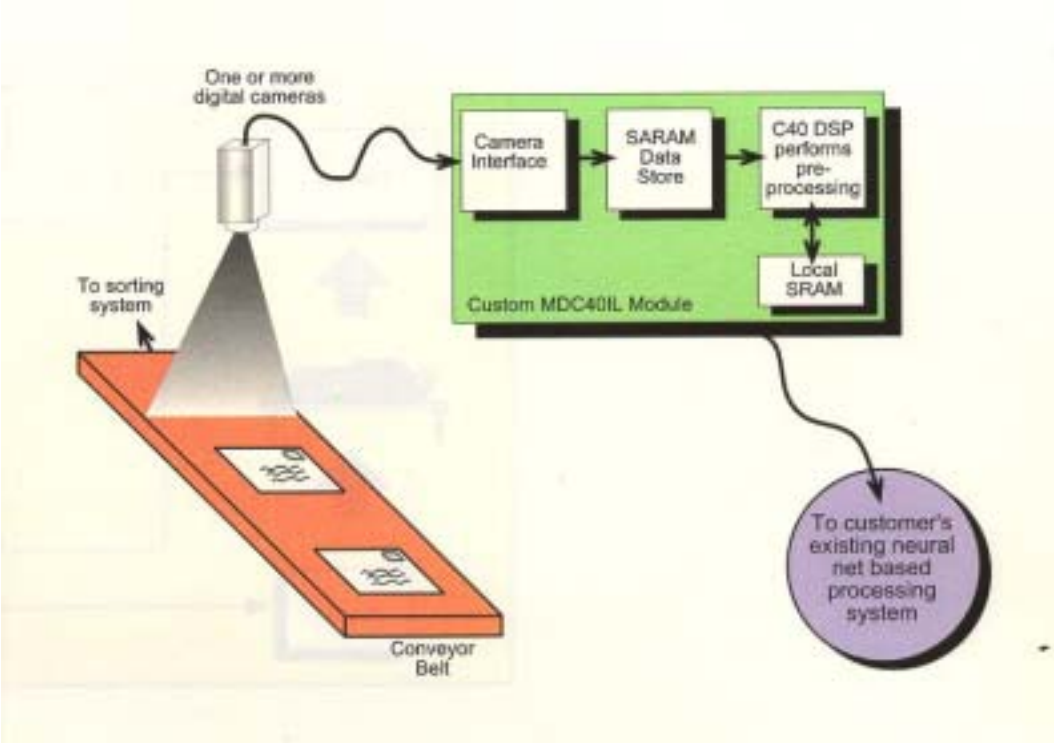
Visual Identification

Example 4: Identification of postal addresses

Requirement:

* detect and classify printed characters.

* detect and classify hand-write characters, etc.



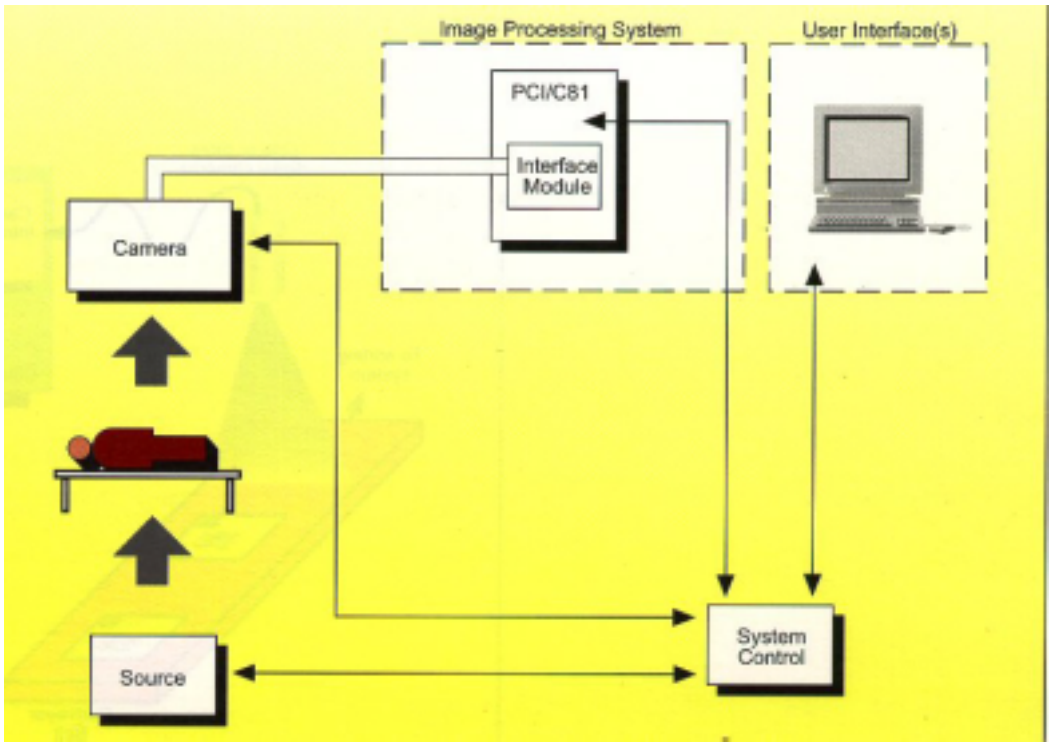
Visual Identification

Example 5: Identification of diseases

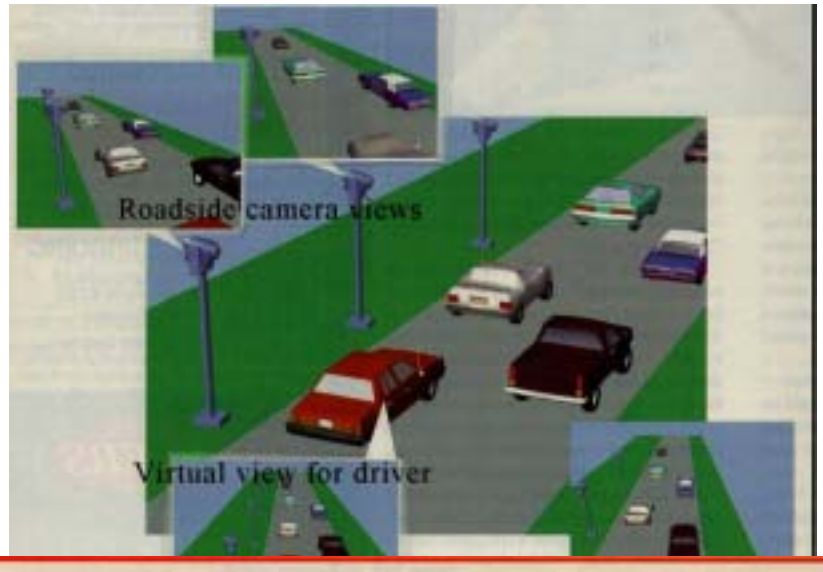
Requirement:

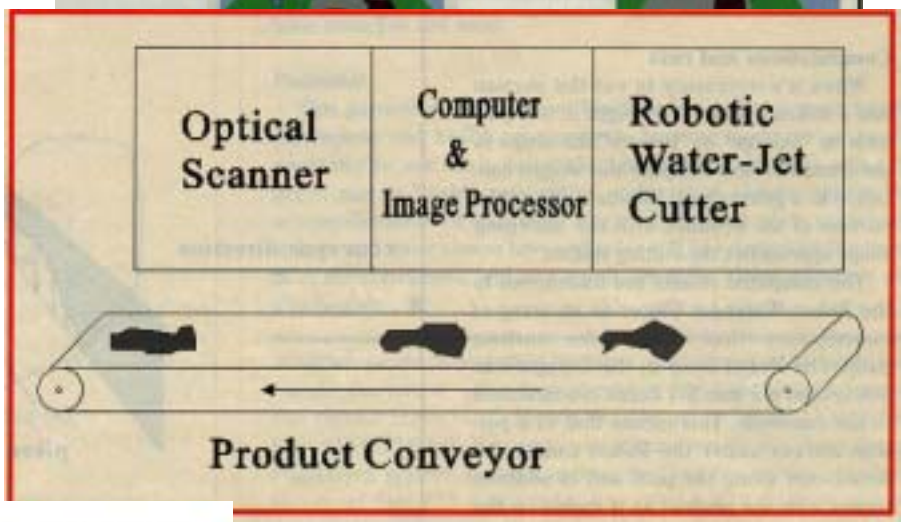
* detect anomalies.

* classify anomalies, etc.



Other Applications

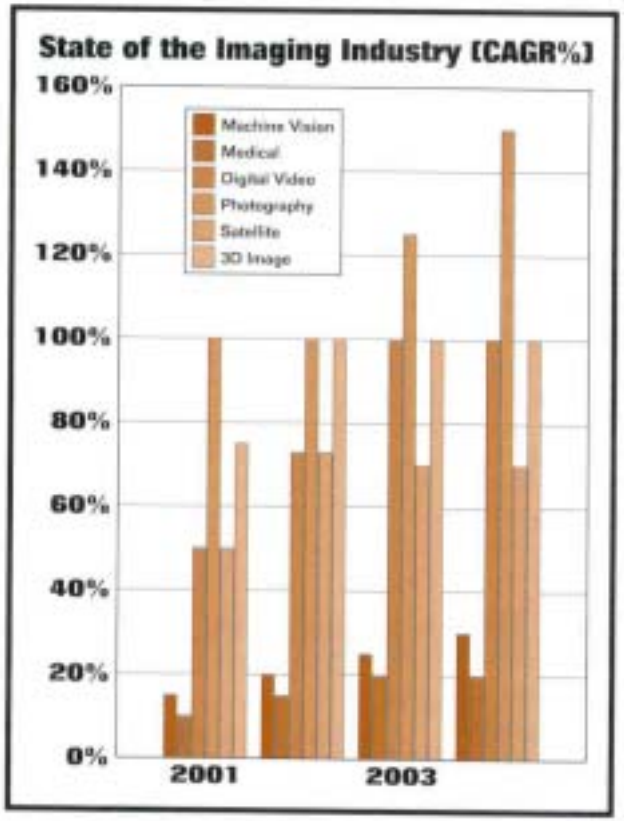




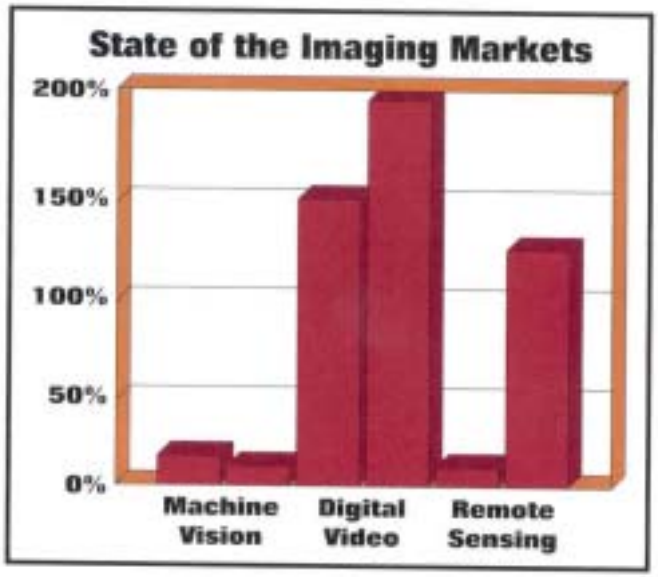
SUMMARY

Machine vision is very useful for many applications:

- Visual Guidance
- Visual Inspection
- Visual Measurement
- Visual Identification, etc.



US$3B in 2005



1999 & 2000