

Introduction to Artificial Intelligence

Department of Computer Science

Lecture 22

Vision credits: Prof. Sven Dickinson

Expert systems

Vision

How can a computer look at the world and derive useful information from what it sees?

- How can a computer look at the world?
 - Camera \Rightarrow brightness array
 - Laser rangefinder \Rightarrow depth array
- What information?
 - objects
 - * identity
 - * location & orientation (*pose*)
 - * motion
 - camera motion

Object Recognition

- how many objects in database
- one object in scene or many
- objects occluded or not
- object and light source poses known or not

Components of an Object Recognition System

- Extract features: lines, corners, regions, . . .
- Group features
- Hypothesize objects
- Verify objects

Simple example: OCR

Single font: template matching

fast, simple and error tolerant but

- cost linear in number of fonts/sizes
- can't handle unexpected font, size, rotation, ...

Omnifont OCR

Graph of features

Indexing

Tradeoff:

- simple index features, e.g. “concave down”
 - reliable and fast, but not very selective
- complex index, e.g. “concave down with straight N-S at right”
 - more selective
 - less reliable (e.g. corner disconnected)
 - slower

3-D Objects

Basic problem: object is 3-D but image & features are 2-D

Same object, different poses \Rightarrow different features

- Viewer centered approach: each object in database \Rightarrow many 2-D models
- Object-centered approach: each object in database \Rightarrow one 3-D model

Example 1: Viewer-Centered Using Pixels

$n \times n$ image \Rightarrow point in n^2 -D space

object model is set of images

data-base is cloud of points in n^2 -D space

Reduce dimensionality of space using eigenvectors,
e.g. 16000-D to 20-D

Transform image to 20-D point and find nearest in DB

Fast but brittle

- occlusion, shadows, markings, ...

Object-Centered Using Corners

- extract edges, then corners
- choose 3 corners and 3 candidate vertices from model
- compute object pose
- look for corners that match other vertices

Object-Centered Using Perceptual Groups

Expert Systems

- A problem: emulate a human expert - easier than non-expert behavior
- A group of techniques for extracting knowledge from a human expert and embedding it in a program
 - Iterative: must have the program to get the specs of the program
 - Rule based programming

Probably the part of AI that has had the most practical impact.