MASSACHUSETTS INSTITUTE OF TECHNOLOGY
PROJECT MAC

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THE SUMMER VISION PROJECT

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The summer vision project is an attempt to use our summer workers effectively in the construction of a significant part of a visual system. The particular task was chosen partly because it can be segmented into sub-problems which will allow individuals to work independently and yet participate in the construction of a system complex enough to be a real landmark in the development of "pattern recognition".

The basic structure is fixed for the first phase of work extending to some point in July. Everyone is invited to contribute to the discussion of the second phase. Sussman is coordinator of "Vision Project" meetings and should be consulted by anyone who wishes to participate.

Goals - General

The primary goal of the project is to construct a system of programs which will divide a vidisector picture into regions such as

likely objects

likely background areas

chaos.

We shall call this part of its operation FIGURE-GROUND analysis.

It will be impossible to do this without considerable analysis of shape and surface properties, so FIGURE-GROUND analysis is really inseparable in practice from the second goal which is REGION DESCRIPTION.

The final goal is OBJECT IDENTIFICATION which will actually name objects by matching them with a vocabulary of known objects.

Goals - Specific

We plan to work by getting a simple form of the system going as soon as possible and then elaborating upon it. To keep the work reasonably coordinated there is a graduated scale of subgoals.

Subgoal for July

Analysis of scenes consisting of non-overlapping objects from the

following set:

balls

bricks with faces of the same or different colors or textures

cylinders.

Each face will be of uniform and distinct color and/or texture. Background will be homogeneous.

Extensions for August

The first priority will be to handle objects of the same sort but with complex surfaces and backgrounds, e.g. cigarette pack with writing and bands of different color, or a cylindrical battery.

Then extend class of objects to objects like tools, cups, etc.

Structure of System and Assignment of Responsibility

(a) Quality Functions- Speciner, in connection with Gosper

An original feature of this program is that it thinks in terms of surfaces rather than lines or contours. So the starting point is a set of functions for surface properties.

Point properties: Three light intensities produced by the vidisector looking through color filters.

Color functions, e.g. ratios of the intensity functions.

Local properties: Texture functions.

Integrals and derivatives of point properties.

(b) Quality Distribution Analysis- Simpson

Programs to select quality functions appropriate to the given scene.

(c) Preliminary Region Proposal- Sussman

Finds connected regions with "constant" surface properties.

(d) Symbolic Picture Model- Lamport

Keeps account of which parts of the picture have been investigated and what regions have been found. Calls (c) until satisfied.

(e) File of Property Lists of Regions- Sussman and Lamport

Parts (c) and (d) end up by proposing a set of regions andestablishing a property list for each region. At this point the property list will contain at least the following information:

Surface quality

Size

Size of boundary

List of boundary points

x-y rectangle

Moments

Contiguous regions

(f) Construction of Principal Boundary- Sussman, in consultation with Greenblatt and Gosper

The program now looks at a fine raster version of the x-y rectangle for each region and produces an ordered list of points on what it thinks is the outer boundary of the region. In later versions it will do the same for inner boundaries (holes).

(g) Curve Properties- White, Geffner, Simpson

Given a list of points, find properties (or measures) such as convex, linear, elliptical segment, smooth (no corners) etc.

(h) Curve Segmentation- White, Geffner, Simpson

The faces of a cylinder might be described as:

Face 1: Convex, smooth

Face 2: 4 segments; line, convex smooth, line, concave smooth. 1 and 3 parallel, 2 and 4 parallel, etc.

This information will be added to the property list.

(i) Global Surface Properties- Benjamin, Speciner

Elementary examples are: shading, highlight detection, local-texture gradients.

Advanced examples are: global texture, surface shape, orientation, etc.

(j) Object Identification and High Level Executive- Henneman, Guzman, Sussman

The general form of the system

The general form of the system is dictated by a desire for maximal flexibility in the addition of "heuristic" rules.

The current proposal is to have a list of heuristic rules of the form PATTERN-ACTION.

The Pattern is matched against a property list of a region. The Action results in a (usually null) modification of the property list using a simple boolean rule or a complex CONVERT program calling any of the functions of the system.

Particular objects or classes of objects are found by using models like the description of the cylinder in (h) as "patterns".