

# Computer Storage and Retrieval System for Two-Dimensional Outlines

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A new operational system designed at the Center for Human Growth and Development provides computer acquisition, storage, and retrieval of high-resolution images of cephalometric tracings. The data structure is such that, on command, any defined distance, angle, area, or perimeter may be easily calculated by computer. Complete tracings, or portions, may be computer-displayed, superimposed, scaled, or moved for form analysis or comparison. Computer pattern recognition programs are not required and the system is generalized so that any two-dimensional outline may be so treated.

Data are collected using a Grafacon tablet† and stylus connected to a PDP-8 computer‡ (Fig 1). The stylus records its x-y location relative to the tablet as the operator traces along an outline. A program developed jointly by this Center and the Con Comp§ project, for the PDP-8, selects points from the Grafacon tablet whenever the stylus has moved more than a small, fixed radial distance of 0.08 inch from the last point stored with a point accuracy of  $\pm 0.01$  inch. All points are initially stored either on paper tape or IBM 360/67 disk files|| using MTS# commands.

A teletypewriter¶ is used to provide identifying information at the beginning of each cephalogram tracing. Landmarks are "tagged" by pushing an interrupt switch (Fig 1). A typical cephalometric image consists of 700 stored points, 70 landmarks, 9 regions, and requires 5 minutes/tracing.

The data are computer scanned for errors and corrected by Center-developed programs. A Calcomp\*\* plot of the data (Fig 2) that is optically superimposed with the original tracing, provides a final check of accuracy.

The data structure is then transformed from a simple list to one keyed for subject number, age, bone regions, and landmarks, which makes

retrieval under a variety of headings simple. Here also the variable number of points on an outline between any two landmarks, due to size differences, is reduced to a constant number by interpolation so that all images have equivalent points.

Analysis of facial growth in an individual or comparison of facial structures in several individuals is facilitated by programs that retrieve points to calculate distances, angles, perimeters, and areas and that pictorially scale and display images for form and shape analysis.

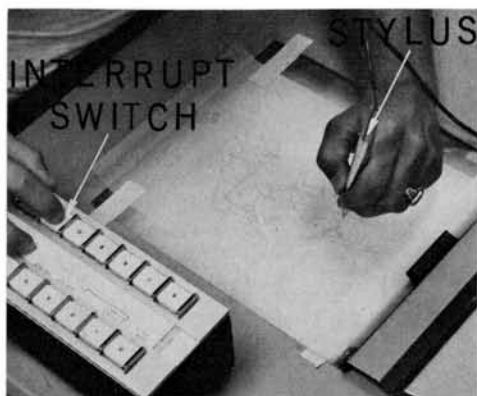


FIG 1.—Tracing shown in position on the transilluminated Grafacon tablet. Digitizing stylus and the landmark interrupt switch are indicated.

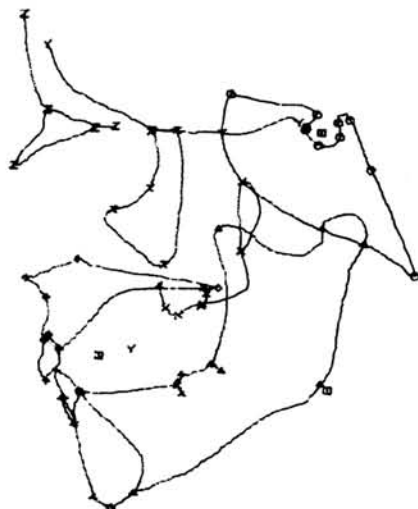


FIG 2.—Calcomp plot retrieved from stored data.

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|| A dual 360/67 located at the University of Michigan Computing Center, Ann Arbor, Mich, USA.

# Michigan Terminal System, a time sharing system developed at the University of Michigan Computing Center for the IBM 360/67, Ann Arbor, Mich, USA.

¶ Model 33, Teletype Corporation, Skokie, Ill, USA.  
\*\* California Computer Products, Inc., Anaheim, Calif, USA.