Technical Report CS74029-R

THE AUTOMATIC DIGITIZER IN COMPUTER GRAPHICS

Charles M. Williams

December 1974

Department of Computer Science, Virginia Polytechnic
Institute and State University, Blacksburg, Virginia

Abstract

An operational hardware-software system is described which rapidly and economically converts hard-copy drawings into graphic data structures faithfully representing both their geometry and their topology. These facilities permit computer graphic console time to be concentrated on the interactive manipulation and analysis of readily accessible graphic data. They can be used to accomplish a large portion of the tedious and error-prone manual tasks historically used for entering such data into computers. The result is that the power of existing computer graphics systems can be enhanced considerably and their domains of applicability be extended into areas not previously considered economically feasible.

Computing Reviews categories: 8.2

Keywords: graphics, automatic digitizers

The figures in this paper are examples of the varied types of complex data which can easily be made available to computer graphics systems if automatic digitizers are included as standard peripheral devices. The source data for these figures were off-the-shelf hard-copy drawings which were digitized by a Visicon Automatic digitizing system [1]. The resultant information was translated into computer graphic data structures by graphic collation software [2,3] and redisplayed on a digital plotter. The times for each processing step were modest, requiring approximately two minutes for digitizing, less than three minutes for graphic collation on an IBM 370/158, and roughly fifteen minutes for replotting.

The system faithfully transduces both the geometry and the topology of the drawings, and the accuracy of the results is a function solely of the resolution of the digitizer, sampling in this instance at two hundred points per inch. The recorded geometries include varying line widths and consequently can accurately represent arbitrarily complex two dimensional designs.

The diversity of the type of information contained in these figures is an indication of the breadth of the role that automatic digitizing processes can play in computer graphics. An immediate consequence is that such processes can rapidly provide the complex graphical data upon which existing computer graphics systems must necessarily feed to become economically viable.

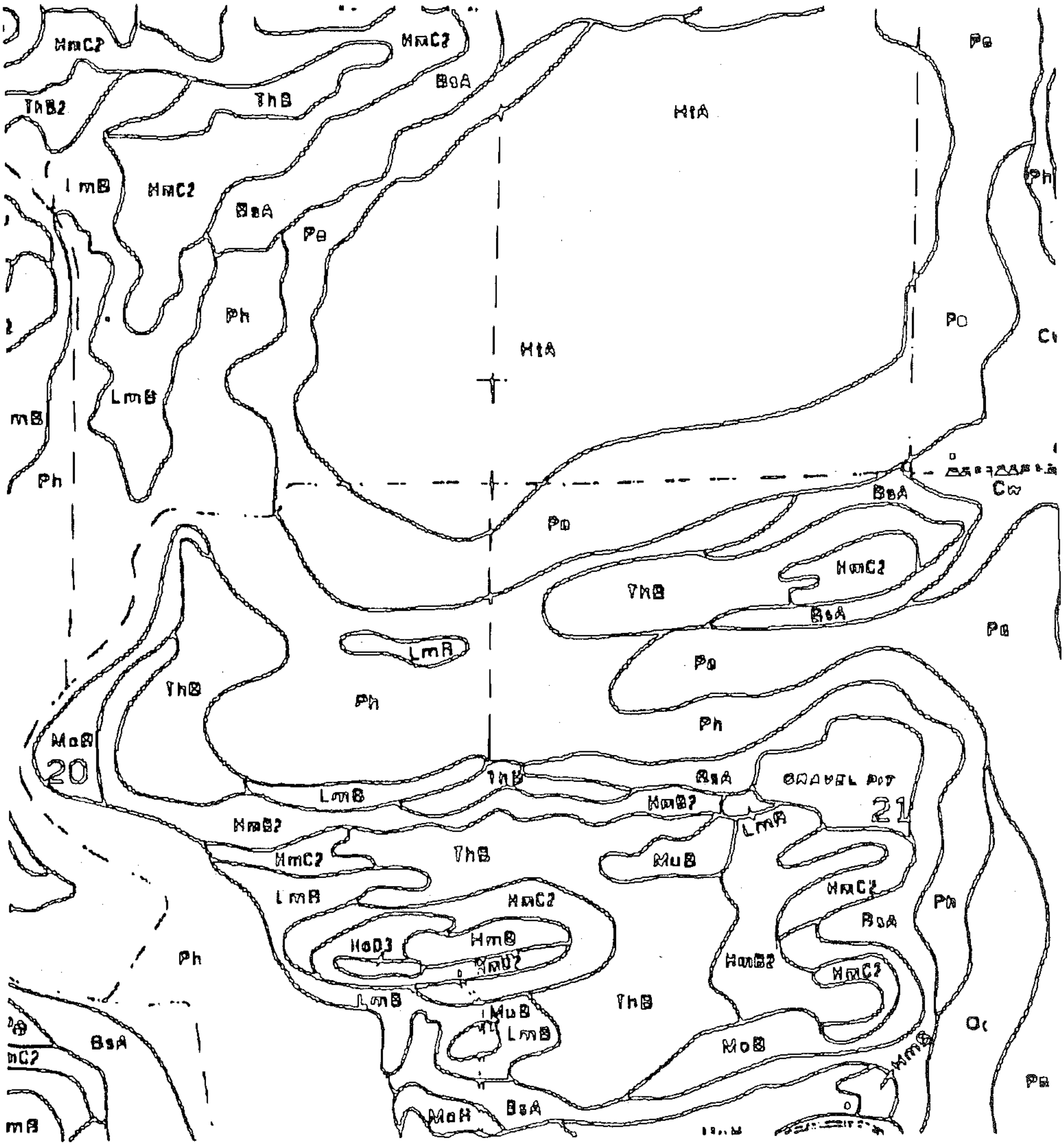
It should be noted that expensive equipment does not necessarily imply an expensive computer graphics process, provided the total process enjoys good job throughput. A major factor limiting the throughput of many current graphics systems is the time spent in acquiring data by means of tedious and error prone manual methods. Such systems can dedicate a major part of their sophistication to the routine editing of mistakes which would never have occurred had automatic methods been employed.

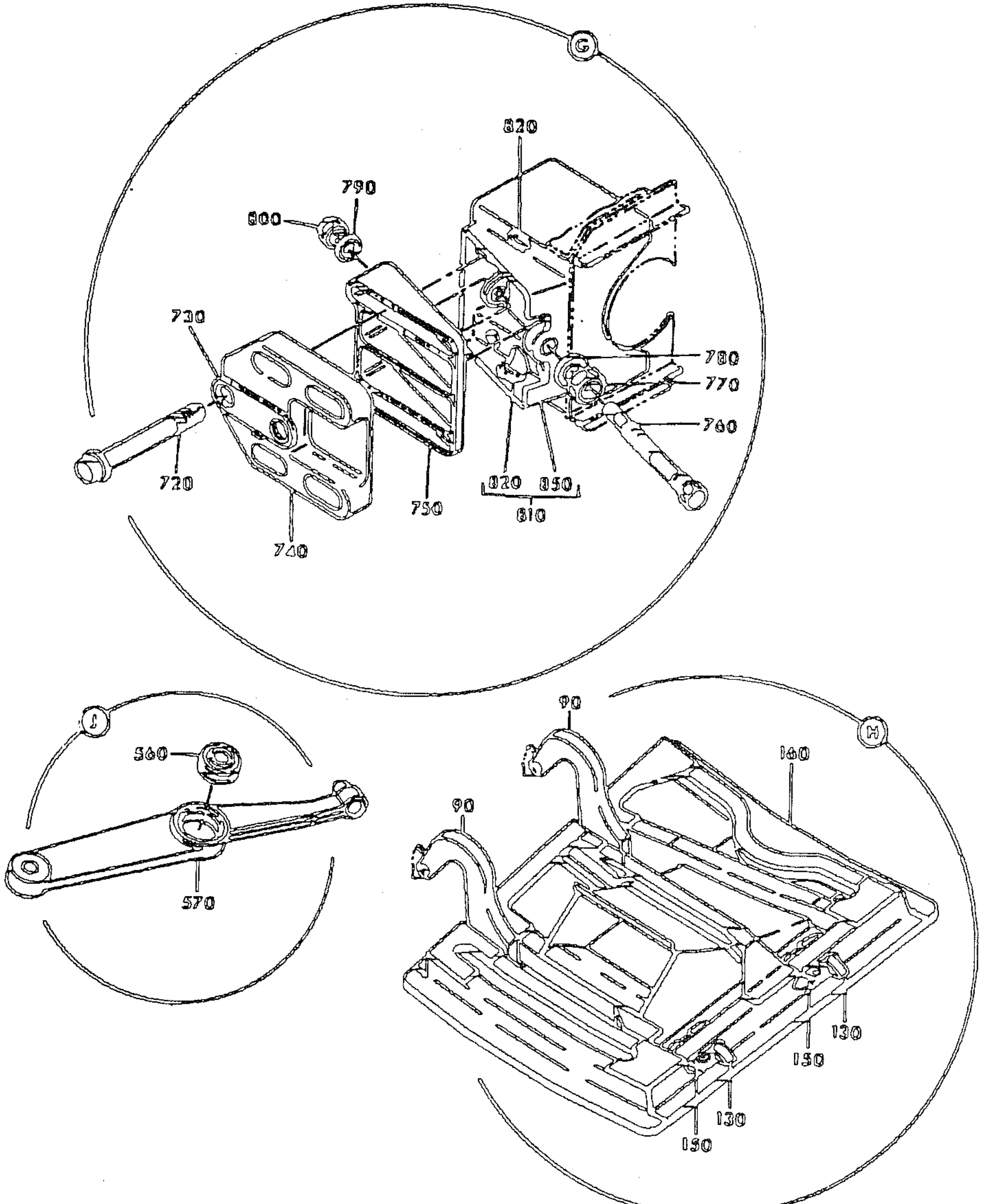
A probable second consequence of automatic systems is the broad extension of computer graphics into new areas. For example, maps as shown in Figure 1 can serve as an immediate source of data for cartographic or regional planning systems [4]. The network descriptions automatically obtained from them may also permit large scale transportation and mobility analyses and even provide direct mechanisms for the retrieval of census data on a geographic basis from data banks.

The assembly drawing in Figure 2 represents another broad field of computer graphics applications in which figures serve merely as pictoral representations of human concepts. These data need not be analyzed, but they do require computer graphic reconfiguration, relabeling, editing, and data compression. Application areas can extend from the complex composition of parts catalogues for major manufacturers to routine poster layouts for the small commercial printer.

Figure 3 is a sample of yet another application area. It is a Computer Modulated Drawing [5] and was derived from a digitized line drawing by dynamically altering (modulating) the derived data structures at the time of plotter command generation. The method is general, and a single digitized drawing can serve as a data source for an indefinite number of different renditions of it. The range of effects in simple cases can be compared to woodcut, needlepoint, hatching, charcoal, or embroidery, but more complex cases cannot be described in such classical terms, This type of computer graphic work can be used in textile and wall paper design, but also shows considerable promise in a broad range of commercial art and printing applications. The power of the process is derived from the fact that the artist's original drawing is transduced intact into the computer without further effort from him. He need not know computer programming nor be constrained by the mechanical restrictions of standard computer graphics systems. He uses the computer to perform the intricate and odious task of redrawing the original in a different style and can then use an interactive system to mend what he does not like. In effect he is using the computer to rapidly generate a rendition of a drawing which he cannot do by hand.

In summary, the figures in this paper indicate some of the power that automatic digitizing systems can give to computer graphics. The incorporation of such capabilities can permit expensive graphic console time to be concentrated on the interactive manipulation and analysis of readily accessible and accurate graphic data. This will permit the computer to operate in its proper domain of drudgery and free the human for his proper domain of judgmental decision. The result will be to considerably enhance the power of existing computer graphics systems and extend their regions of applicability into areas not previously considered economically feasible.


HmC2
HmC2
ThB2
ThB
BsA
HtA
LmB
HmC2
BsA
Pe
Ph
HtA
Po
LmB
Ph
Cw
BsA
Po
ThB
HmC2
BsA
LmB
Po
ThB
Ph
Ph
MoB
20
LmB
ThB
BsA
GRAVEL PIT
HmB2
21
LmA
HmB2
HmC2
ThB
MuB
LmB
HmC2
HmC2
Ph
BsA
HmD3
HmB
Ph
HmB2
HmC2
LmB
ThB
MuB
LmB
BsA
MoB
Pe
BsA



C04-1682

DUCT ASSY-FIXED REVERSER AND FAN
FIGURE 1 (SHEET 3)

References

1. Broomall Industries, Inc. 682 Parkway, Broomall, Pennsylvania, 19008, U.S.A.

2. Williams, C. M., 'The Automatic Transduction of Drawings into Data Bases', Proceedings of AFIPS 1973 National Computer Conference (June 1973), pp. 635-637.

3. Williams, C. M., 'The Role of Automatic Digitizers in Computer Aided Design', Proceedings of CAD74 International Conference on Computers in Engineering and Building Design, Imperial College, London (September 1974), IPC Science and Technology Press, Ltd.

4. Williams, C. M., 'The Role of Automatic Digitizers in Demography', Annual Meeting Southern Regional Demographic Group, Atlanta, Georgia (October 1974).

5. Williams, C. M., Sarvis, A. T., "Computer Modulated Drawing", Southeastern College Art Conference, Chapel Hill, North Carolina (November 1974).