Print Layout and Design with a Computer CRT System

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This paper is a report on an investigation into the feasibility of using a computer equipped with a CRT display for layout and design work. This investigation was mainly concerned with ascertaining whether a CRT system could create images of sufficient typographic standard, while allowing the size of face to be such that a realistic layout of a page could be represented at any one time. The work was essentially exploratory in nature, but enough was done to enable some conclusions to be drawn.

The most interesting prospect for the use of computers in the printing industry perhaps lies in the field of typography and layout. It should be possible to write computer programming systems that can be run on a computer equipped with a cathode ray tube display to provide the layout man of ability with a tool that could increase both the quality and the quantity of his work. The principal value of such a system is that a layout man would appear to have a type encyclopedia literally at his fingertips. Also, according to need, the display screen would show him the layout he is working on either for over-all effect, for positioning of matter, or for the detailed specification of a part. Specimen typefaces could be called onto the screen and tried at various sizes within the space of seconds. When the complete layout has been settled to the man's satisfaction, it could be recorded on magnetic tape in readiness for automatic typesetting at a later stage. A computer-based system for layout and design work would, by its power and speed, introduce into the normal typesetting process extra time to produce better quality work.

The Work

The first step in the exploration of the feasibility of the above idea was to test the adequacy of a computer display with regard to the definition of images. Fortunate access was gained to the PDP-7 computer at the Cambridge University Mathematical Laboratory,[1] a machine on which N. E. Wiseman had already shown the possibilities of text editing using a computer display.[2] The main emphasis of the pilot work was therefore on the ability of the display to represent specific typefaces to a sufficient typographic standard, while allowing the size of face to be such that a realistic layout of a page could be represented at any one time.

A computer program to control a display consists of a series of instructions directing the path of a beam over a grid of 1024 points by 1024 points making a 9-3/8″ square on the tube face. To create a character on the screen requires a set of instructions that will generate a representation of that particular character. Each set of instructions that describes a character to the display is treated as a unit in itself and is known as a character generator subroutine. Subroutine is a computer term that denotes a set of instructions that are thought of as a logical unit. An alphabet is described to the computer as a set of character generator subroutines, one subroutine for each letter. A line of text is then represented within the memory of the computer as a series of calls to these subroutines. This makes for economy of storage, as a call to a subroutine will take up only two locations in the memory, whereas the character generator subroutine can take anything from 5 to 50 locations.

The first face that was chosen for this exploratory work was Perpetua, and the second, Gill. Owing to a shortage of time and also the extremely laborious method of programming the display, only a few letters in each face were represented on the screen. However, the results were encouraging enough to show that a design system is feasible. In terms of the CRT grid, a unit of 18 points high and 18 points wide was used in which each letter was represented. For the letters chosen, programming took up between 8 and 32 memory locations per character.

[1] I should like to thank Prof. M. V. Wilkes for allowing the use of the machine and Mr. N. E. Wiseman for invaluable advice on programming and operating the machine.

[2] N. E. Wiseman, A Scope Text Editor for the PDP-7/340, University Mathematical Laboratory, Cambridge. (Tech. Memo. 65/3).

The chosen letters were programmed only once for each face but were displayed at different sizes and intensities of beam by using the programming features of the computer. This showed that one could have great economy of storage of character generator subroutines for layout purposes, while at the same time providing an accurate "feel" of the layout.

First of all, the set of characters was displayed more than once on the line, but a difference was made between the brightness of the sets, which showed the flexibility that can be gained by varying the intensity of the beam. In this way light, bold, and ordinary faces can be shown without the necessity of the computer to store completely different sets of character generator subroutines. The light and bold effect can be simulated by varying the intensity of image that the beam traces.

Another feature of the computer that was exploited was the facility to vary the size of an image by merely setting a scaling factor. To examine this feature the characters were first displayed at the top of the screen in their absolute size of 18 units high. Then the same character generator subroutines were used to display the characters further down the screen, but the scaling factor was set to 2. This operation was repeated twice more with the scaling factors of 4 and 8. In this way the same character generator subroutines were utilized to display simultaneously the characters at four different sizes (Figure 1). The

Figure 1.
Perpetua and Gill characters generated on CRT display.

purpose was to discover the point at which the image lost validity due to over-expansion of the basic pattern. It was found that the image scaled by 2 was excellent; by 4 was still good; and by 8, although obviously patchy, a fair impression was retained. This suggests that another saving could be made in terms of storage of character generator subroutines by judicious programming of a basic size and scaling it up. Obviously, with a restriction of scaling factors of 2, 4, and 8, there would have to be a set of basic sizes for any typeface.

Experience showed that an 18-point grid was not ideal for the purpose of displaying a specific typeface. It is felt that 24 points are perhaps needed in the vertical plane to represent a face in 6 point; therefore 40 lines could be accommodated on the screen, with 80 characters to the line, allowing 12 points in the horizontal plane per character.

Suggested Features of a Complete System

If the basic feasibility of using a computer CRT for layout work is accepted, what features must the programming system provide so that the computer can be used as a comprehensive design aid?

A control program resident in the computer must accept text items, entered from a computer keyboard, and commands to set the text in a particular typeface. A light pen can be used to command the system to perform an operation on that text, either to move it about the screen, reset it in another face, or change the size. The layout man should also be able to 'draw' in, by means of the light pen, rough representation of half-tone pictures, slabs of colour and outline drawings. One point that needs careful thought in any proposed system is that the intensity of images will vary greatly according to the amount of matter on the screen.

Another feature that a system must provide is an allowance for the times when the display will not be large enough to carry the whole layout in detail. The program should permit the visualiser to change focus, as it were, by first giving a general impression of the whole, then homing in on a part of the design to represent type in detail, followed by a return to the general view to review any change in the over-all effect of the layout. This last feature will need a fair amount of immediate access memory store to carry the programming for more than one display picture.