

XVIII. CIRCUIT THEORY

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A. SENSORY AIDS PROGRAM: READING MACHINES

In connection with the Sensory Aids program, a study was made of previous reading machines for the blind, and also of proposed methods and devices that might enable blind persons to read printed text. As a result of this study, we concluded that our initial efforts would be directed toward the development of a machine for complete character recognition.

In the terminology of the sensory aids field, a "recognition" reading machine makes the decision of identification of an input character from its input geometrical configuration, and presents this identification to the operator of the machine. A different type of reading machine is the "direct-translating" machine, in which no attempt is made to have the machine make the character identification, but rather, its function is only to transform (translate) geometrical proportions of the character that is being scanned into modulations of its output signal, which are usually auditory or tactile. Since in the direct-translating machine the information content of the output and input is the same, and because of the redundancy in the geometry of the printed alphabet, the information content at the output far exceeds the capacity of the aural or tactual channels at all but the lowest reading speeds. Several different types of direct-translating reading machines have been built and tested, the earliest (1) of which was constructed in 1914, and, indeed, consistent reading rates higher than 20 words per minute have rarely been attained with these machines (2).

The recognition machine, however, processes the input-character geometry sufficiently to permit much higher reading rates, according to the output medium selected; for example, if the output is in the form of syllables, the ultimate presentation to the reader might be synthesized speech, transmittible at rates of several hundred words per minute.

The recognition machine that is envisioned at the present time is composed of three fundamental parts: (a) the input head, or scanner; (b) the detector; and (c) the logic section (see Fig. XVIII-1).

The scanner is a mechanical-optical system that, for the purposes of explanation, repeatedly sweeps two small adjacent spots of light vertically through a single line of print. These illuminated areas are small compared with the size of the character that is being scanned, and are arranged horizontally (see Fig. XVIII-2). The reflected light from each scanning spot is separated from that of the other spot and fed into separate photodiodes. The vertical sweep is automatic, and the horizontal motion is supplied by the operator.

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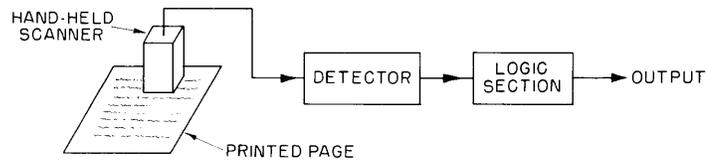


Fig. XVIII-1. Block diagram of recognition machine.

The detector utilizes the outputs of the photodiodes to determine, principally, three important characteristics: (a) the length of vertical lines, (b) the number of nonvertical lines crossed, and (c) the slopes of each of the nonvertical lines crossed, in each vertical sweep. For instance, scanning a capital "N" would result in the following sequential information: the presence of (a) a long vertical, followed by (b) a single line-crossing (in a vertical sweep), with a negative slope, followed by (c) another long vertical. The output of the detector consists of a number of binary outputs, a certain combination of which is presented to the logic section upon the completion of each vertical sweep by the

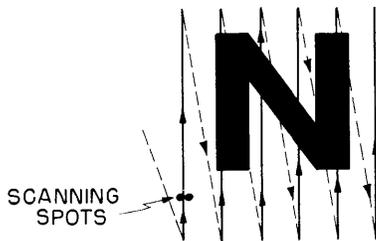


Fig. XVIII-2. Path of scanning spots as scanner of Fig. XVIII-1 is moved across the capital letter "N".

scanner. The logic section then utilizes the sequential output of the detector to identify each character as the scanner is moved horizontally across the line. An attempt is being made in the design of the detector to eliminate errors resulting from changes in the type-face style that is being scanned.

Note that the scanner and detector alone might be used as the basis for a reading machine of a type that is intermediate between the recognition machine and the direct-translating machine. The addition of some form of simple logic after the detector, to present the detector output directly to the reader only when the detector output changes, would reduce a great deal of the redundancy that is inherent in direct-translating machines. Another type of intermediate machine might be one that presented only certain meaningful, preselected combinations of the detector output to the reader.

Construction of the scanner and detector is now going on. Work on somewhat similar reading machines (3) is being carried on elsewhere, with different applications in mind (4). This investigation has the specific objective of determining whether or not a recognition machine can be made practicable for blind people.

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References

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3. D. H. Shepard, B. F. Bargh, and C. C. Heasley, Jr., A reliable character sensing system for documents prepared on conventional business devices, IRE WESCON Convention Record, Part 4, 1957, pp. 111-120.
4. A bibliography on reading machines has been compiled by the Research and Development Division, Prosthetic and Sensory Aids Service, Veterans Administration, 252 Seventh Avenue, New York, N.Y.