SJC - 6

MEMORANDUM TO: Dr. R. S. Hirsch April 10, 1957

SUBJECT: A Preliminary Proposal for a Research Project on Facsimile Character Perception Error Rate as a Function of Signal Generation Method, Matrix Resolution, Transmission Line S/N (Random and Impulse), Type Size and Other Conditions.

Introduction

This problem is an investigation of the character error rate in facsimile scanning, transmission, and printing, and human reading. The problem is proposed in its more general form in an attempt to include possible applications to matrix character printing, transmission of computer output data in matrix form, and source document transcribing into facsimile signals.

This information to be obtained from this project would be potentially useful in the following areas:

(1) Communications Project, San Jose: Information on the relationship between the bit error rate and the character perception error rate would be useful in the multi stylii, parallel by row, serial by column, serial character display device.

(2) Direct Access Photomemory Project, San Jose: The usefulness of error rate data is being reviewed.

(3) Information Research Project, Poughkeepsie: This proposed project may be of significance in some of the character sensing work and engineering psychology work.

In the communications project applications, the signal to noise ratio (S/N) would be higher than in the Informax project. For engineering economy the tendency is to use poorer resolution, i. e., seven rows per character height. This gives a poorer alphabet. The transmission of business data involves less redundancy than in general communications, so the probability of error in an individual character is more important. A suggested range of error rate to fix range of the research is proposed of zero to five errors in 1000 characters which might be attainable by making S/Nhigh enough.

I. Generation or Scanning a Character

It is proposed that several methods of generation of matrix character facsimile signals be used.

a. Readout of character signals from storage.

This could be readout from selected track and/or sectors of a magnetic disk or drum. It could also be derived from a printed circuit

code disk with contact brushes or with an optical readout system. This system would generate facsimile signals for characters as shown in Figs. 1A, 2, and 3.

b. Optical Scanning of Solid Printed Characters

This would produce discrete signals as in the above system by setting of suitable clipping levels and timing gates. The problem of registration would introduce some errors which would be compensated by higher resolution (lines/char. height).

c. Optical Scanning of Matrix Dot Characters (Wire Printer Style).

This would be similar to above with the registration errors becoming more serious. In addition variation in blackness of dots would contribute further errors.

d. Resolution of Matrix Character Signals.

It is proposed that three levels of resolution be used in preparing the above matrix character signals as are illustrated in Fig. 1 - 3.

(1) 5 x 7
(2) 7 x 9
(3) 10 x 14

II. Simulation of Transmission Errors.

It is proposed that both random noise and impulse noise be added to the character signals generated in the program of paragraph 1 for a range of signal-to-noise ratios (S/N) and different values of transmission channel bandwidth (F), transmission rate (H), and type of modulation.

At this stage of understanding of the problem it is felt that impulse noise can become more important at lower resolution. Impulse noise which might be tolerable for a 10 x 14 matrix character might require raising the S/N ratio to get equivalent accuracy with a 5 x 7 matrix. There may be a higher probability of impulse noise causing confusion between certain pairs of characters such as (C, G) (O, Q) (P, R) (8, 9) which could be reduced by redesign of the alphabet. This could be done by a simulation program on a computer or by an experimental set up with noise generators. If tables of impulse noise can be estimated the computer simulation program might be more economical.

The result of this stage of the project would be a set of tables from which degraded facsimile characters could be drawn or printed as are illustrated in Fig. 1B. The samples illustrated use square dots. An alternative method would be to use round dots corresponding to round wire printing electrodes.

III. Human Recognition of Degraded Characters.

It is proposed that cards with matrix characters produced under the different conditions described in paragraph 1 and 2 be examined by human subjects under standard conditions to determine the probability of human error in reading the degraded characters. The procedures used at Tufts University on the Informax Project * appear to be applicable to this work.

a. Format of cards.

It is proposed that tests be made with a full complement alphanumeric characters and special characters in scrambled order in six lines of 32, 16, 8, 4, 2 and 1 characters per line to simulate variable message lengths including control signals.

b. Distance, Illumination and Type Sizes.

It is proposed that an applied psychologist be consulted as to what conditions would be desirable.

F. B. Wood

FBW:hp

cc: Dr. W. A. Christopherson
Mr. R. L. Haug
Dr. M. M. Astrahan

* Hogan Laboratories, Report No. 1176-FR-10. "Final Engineering Report on Informax" 30 Nov. 1953. AF 33(038)17923. Also Report 1176-FR-12, 15 Feb. 1955. (AD-61548)

Bit Size

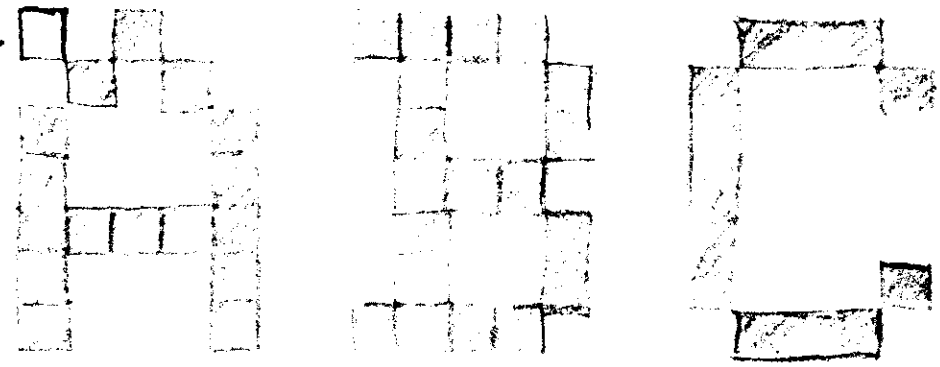

Fig 1A - 5 x 7
Five

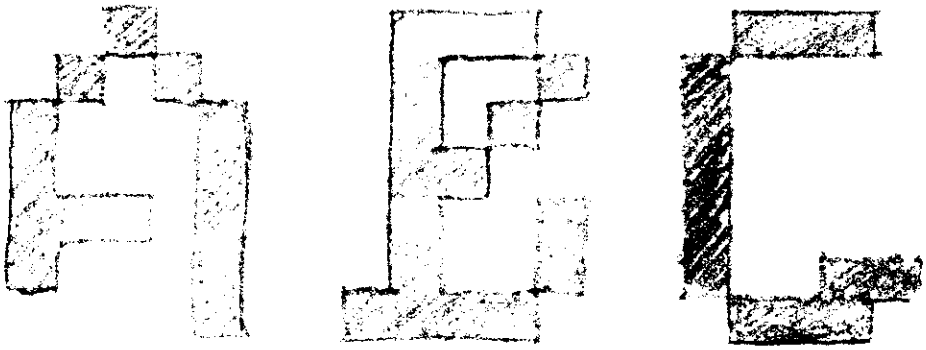

Fig 1B - 5 x 7
8 ± 5 errors in
3 conditions.

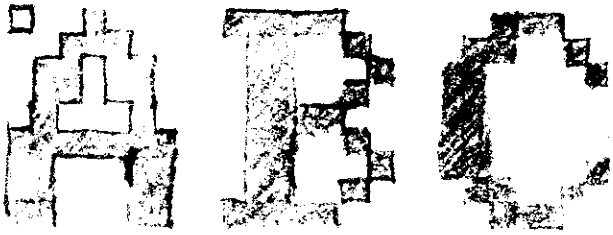

Fig. 2 - 7 x 9

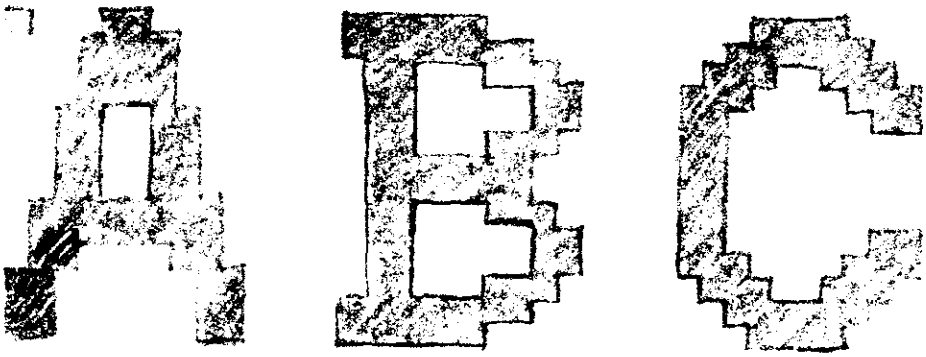

Fig 3 - 10 x 14