

XXII. COGNITIVE INFORMATION PROCESSING

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1. NATURAL LANGUAGE PROCESSING

National Science Foundation (Grant SED76-81985)

Jonathan Allen

The objectives of this project are changing from research in text-to-speech conversion for English to speech recognition. For over ten years, a unified set of research projects has focused on the construction of a comprehensive text-to-speech system and it is now felt that this work has reached a level of maturity and quality (of the output speech) so that the resulting system can be successfully exploited in a variety of applications, including computer-aided instruction, reading machines for the blind, and general-purpose computer output devices. There is a wide variety of capability contained in the system, including morphological analysis, letter-to-sound and lexical stress rules, parsing, timing, and pitch determination, phonological adjustment rules, and phonemic synthesis leading to the final output speech waveform. The several algorithms treating the constraints due to these domains have been developed to a high level of performance, and have been comprehensively tested.

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We are now turning to a complete documentation of the system, in the form of a monograph, as well as a short course which will make the results available to the general public. There is, however, a continuing concern with practical electronic implementation, and we are utilizing techniques for custom integrated circuit design to construct devices for the high-data-rate signal-processing algorithms. We believe that the entire system can be implemented, using state-of-the-art electronic technology, in the space of a small book, and at a cost appropriate to a wide range of systems.

As the text-to-speech work is completed, we are preparing to start a major project in speech recognition. We feel that it is possible to recognize individual segments and words at a much higher level of accuracy than is now done. The approach centers around the recognition of syllable peaks, and the selective focusing on relevant cues rather than straightforward template matching. This approach requires a careful determination of the way in which cues integrate to form a percept, and the conditions which determine the subset of cues being used in particular environments. In order to collect the large amount of data needed, a computer-based "phonetician's assistant" to provide for efficient interactive examination of distributional phenomena will be developed. New techniques for syllabically anchored lexical lookup will also be developed, although current plans do not provide for initial emphasis on the heavy use of syntactic and semantic constraints.

2. DIGITAL WIREPHOTO SYSTEM

Associated Press (Grant)

Donald E. Troxel, William F. Schreiber, Richard S. Damon, John N. Ratzel

Since August 1970, we have been developing a news picture (Wirephoto) distribution system that is entirely new for the Associated Press. It is being introduced in stages, in such a way that at least the present standard of quality and service will be maintained everywhere, with improvements spreading gradually to all locations.

Pictures are stored under computer control. An editor can then view any picture on a TV display in order to select, discard, edit, transmit, or store that image for later automatic dispatch. Editing may include cropping, enlarging, reducing, tone-scale enhancement, sharpening, combining, and addition of captions. No additional chemical photographic work will be required for any of these picture-processing operations.

Transmission over the "backbone" system linking AP bureaus and large metropolitan newspapers that have substantial computer facilities will be via high-speed digital links and will originate and terminate generally at computer-controlled digital storage devices. Transmission to subscribers will be analog or digital and at speeds and scanning standards appropriate to the existing transmission facilities. Complete control

will be exercised by the New York network monitor. In the absence of manual interventions, transmission to all points among the bureaus, from point to point, and to regional networks, will be accomplished automatically.

We have implemented some of these procedures in the laboratory, using a PDP-11 computer (300-megabyte disk). The input may be a picture from the AP network, from a local analog transmitter, or from magnetic tape, and is stored on a disk. Pictures may be transmitted from the disk to comparable receiving points. Pictures stored on the disk may be viewed on a TV display utilizing a full-frame storage system. Editing facilities already in operation include cropping, enlarging or reducing, combining several pictures into one, addition of captions, and sharpening.

The multitask software operating system permits new picture-processing routines to be integrated easily, and we plan to keep incorporating additional picture-processing routines into the system.

We are particularly interested in picture-processing operations in which the processing depends on the local content of the picture. That is, the detailed parameters of a coding or enhancement scheme vary for different local areas. In this type of processing it is of prime importance to avoid artifacts such as contours outlining these local areas. We are also accelerating our interest in color picture processing, both from the viewpoint of coding for bandwidth compression and enhancement or manipulation.

The Associated Press has now installed the computer-based image processing system in New York City. It is initially being used to coordinate the newsphoto transmissions between the domestic and international Wirephoto networks.

3. DATA PROCESSING FOR THE GRAPHIC ARTS

Providence Gravure, Inc. (Grant)

William F. Schreiber, Donald E. Troxel, Leonard Picard, Malik M.A. Khan,
Frank Tze-pu Chang

The aim of this project is to explore the feasibility of digital processing and computer manipulation of graphic arts quality images which are intended to be duplicated on printing presses. Specific areas of investigation include data compression, tone-scale reproduction, enhancement, input/output hardware and software, and the economical storage and retrieval of very large amounts of pictorial data.

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4. IMAGE PROCESSING FOR THE GRAPHIC ARTS

Taylor Publishing Company (Grant)

Donald E. Troxel, William F. Schreiber, Phuong-Quan Hoang, Neil M. Eisman

Taylor Publishing Company is developing a computer-based system for producing printing plates for yearbooks and similar publications. This type of printing is characterized by a very large number of different pages, most containing many pictures, and by small runs compared with most other publishing. Thus the cost of plate preparation is a high proportion of the total production cost. The purpose of the MIT project is the development of an improved system for the input and processing of the graphical elements – pictures and other nontypographical matter – to be included in the final pages. The improved system is to feature lower cost, higher speed, and no loss of quality through the application of interactive computer techniques.

The work to be done at MIT consists of the design of a scanner station and its operating system. Physically, the station, which itself will be a satellite of the Taylor Publishing Company's publishing system, comprises a small computer with associated peripherals. These include a picture display, full-frame memory, disk memory, tablet and Autokon scanner. The operating system will permit the station operator, sitting in front of the computer console, to perform, interactively, the following operations:

1. Receive layout instructions for each page, from the central system, including location and size of graphical elements.
2. Scan pictures into the system using parameters derived from the layout information.
3. View scanned pictures on the display and perform aesthetic corrections, if required. View entire page on display to verify layout.
4. Organize graphical data in local memory as required by page layout and initiate data transfer to the central system.

The novel features of this system revolve around the use of a small computer, in combination with a graphics arts quality laser scanner and some special-purpose digital hardware, to permit input of graphic elements, aesthetic corrections, and the organization of data for each page according to layout information, all on an interactive basis, and in a cost-effective manner.

5. DIGITAL COLOR TV CODING

Sony Corporation (Grant)

William F. Schreiber, Donald E. Troxel, Robert R. Buckley, Geoffrey J. Bunza

The object of this research is to produce commercial quality color TV pictures using a data rate low enough to facilitate applications at present nonfeasible or too expensive. The technique uses separate coding of luminance and chrominance components, with previously developed monochrome coding methods being applied to luminance. Initial work has been done by computer simulation. Design of a real-time (hardware) coder is under way.

