A COMMUNICATION SYSTEM FOR THE SEVERELY HANDICAPPED, INCLUDING COMPUTER TERMINAL OPERATION

D.W. Lywood and J. Vasa, Bio-Medical Engineering Unit, Queen's University

ABSTRACT

The aim of the work reported was to provide mentally alert individuals who have high level spinal damage with a system to enable them to communicate with other people and with equipment.

A two channel input was provided from the user by means of microswitches or other transducers such as suck blow switches to select a modified ASCII code. Standard ASCII code words assembled in a buffer were decoded to operate the keys of a typewriter, computer terminal, or to select a service.

Different methods for the assembly of the ASCII codes are described and evaluated in terms of typing speed.

The Departments of Rehabilitation Medicine at Queen's University and Kingston General Hospital were responsible for the care of two young high level quadraplegic patients.

The aim of the work was to provide individuals such as these with a system to communicate with other people and with equipment. In particular it was hoped that this system would facilitate the education of such individuals and provide them with a means of pursuing creative work and employment.

It was the authors' opinion that computer programming from a remote terminal would be a possible occupation for an intelligent severely handicapped individual since it does not require the transportation of the individual nor does it require continuous assistance for mailing and packaging materials.

A study of previously reported methods and equipment [1-11] failed to locate an existing system that would provide the required communication ability.

To communicate directly with machines such as computer teletype terminals, the system was based on the American Standard Code for Information Interchange (ASCII) rather than simpler codes for the selection of a few services or for typing.

In selecting a method to meet our requirements, some of the most suitable techniques of the previously reported work were adopted with the constraint that the system chosen should minimize the physical demands made on the operator. Socially embarrassing, obtrusive connections to the operator's person were avoided.

A two channel input was employed that could be provided either by a pair of transducer microswitches or by a single transducer. Four methods were considered for the assembly of the ASCII code.

1) Sequential Setting -- in which the user operated either channel 1 or channel 2 to set a binary "1" or "0" in each of the buffer locations.

2) Single Pulses -- in which the user operated one channel a number of times to represent an octal digit, then the 2nd channel to deposit this digit.

3) Gated Pulses -- in which the user operated one channel to allow the requisite number of clock pulses through, then the 2nd channel to deposit the octal digit.

4) Optical Selection -- in which characters were selected by means of a focussed light beam.

The first three methods were tested in mock-up form. The latter is the subject of a separate study.

A small digital computer, its associated teletype terminal and digital logic modules were used to carry out a preliminary study to evaluate different coding methods and hardware. The results of this study will be discussed.

The current system (Figure 1) consists of the following main parts:
The Transducer -- incorporating Fairchild PSF-100A low pressure sensors to respond to "suck" and "blow".
The Coder -- which contains an adjustable digital clock, a data distributor and an output buffer. Audio tone bursts signal the passage of pulses through the gate. Indicator lights display the state of the output buffer.
The Teletype Interface -- which causes the teletype to send ASCII code after the Coder output buffer has been filled.
The Decoder -- which decodes ASCII code into one of 128 output lines, 67 of these are used for typewriter characters or functions, the remainder being available for selecting other services.
The Case Interrogation Unit -- which is necessary to determine if a selected

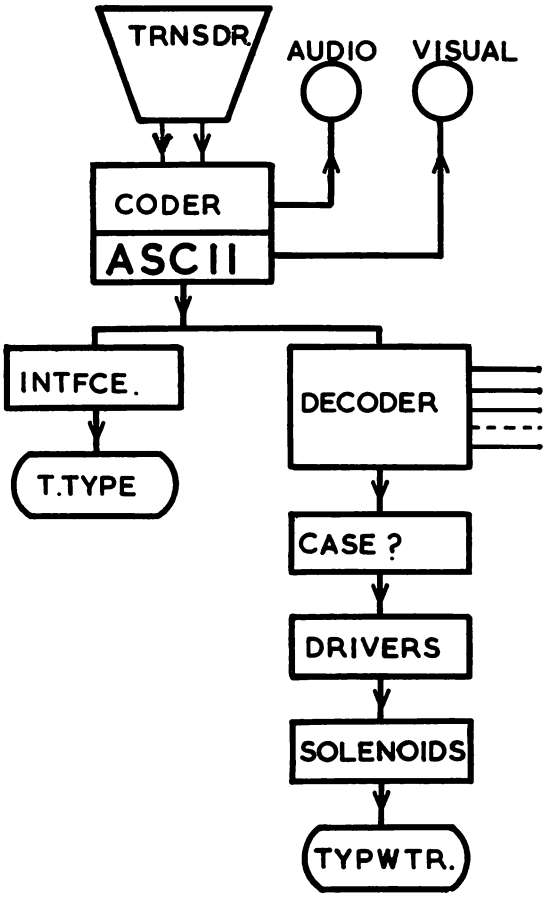

Figure 1

character is in upper case type, in which case its execution is delayed while "shift" is executed. "Shift" may be selected to type a single capital letter or "Shift Lock" to type a series of capitals.

A Connecticut Technical Corporation model SP-200 solenoid operating unit is employed with an IBM model 723 "Selectric" typewriter. The latter was fitted with a pin feed platen to allow the use of continuous stationary.

All the logic circuits were assembled from TTL integrated circuits.

The standard ASCII code consists of three octal digits, the most significant being either a "3" for alphabet, or "2" for numerals, functions, and most special characters. To avoid assembling three octal digits for each selection, the system requires the operator to deposit only the least significant two octal digits, then automatically enters "3" as the most significant digit, unless an extended second channel operation ("suck") is used to deposit the least significant digit. In this case "2" is entered as the first digit.

Preliminary trials with this system indicated that it would meet the specified requirements. Current work is aimed at employing a more rapid coding method for selecting a subset of characters and services.

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