Clinical Testing and Assessment

Using a microcomputer for on-line psychiatric assessment

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The on-line computer-assisted psychiatric system has been shown to be effective in bringing about an improvement in mental health service delivery. However, it was initially developed on a computer system that was too costly for most potential users. The present paper describes the approach used to implement the on-line assessment system on an inexpensive microcomputer, the PDP-11V03.

The Psychiatric Assessment Unit (PAU) at the VA Hospital in Salt Lake City makes use of on-line computer technology to improve intake decision making. This system was designed to allow the completion of comprehensive psychological evaluations on patients at the time of application for care (Williams, Johnson, & Bliss, 1975). Part of the evaluation data are gathered directly from patients using interactive cathode-ray-tube (CRT) terminals. Other data are collected by paraprofessional personnel who, prompted by schedules on the CRTs, enter information into the system. The computer analyzes these data and prints assessment reports. The system now in operation uses on-line computer technology to complete a timely, inexpensive, and comprehensive evaluation that is useful for intake decision making (Cole, Johnson, & Williams, 1975; Johnson, Giannetti, & Williams, 1975; Johnson & Williams, 1975).

The functional operation of the PAU can be described briefly. A receptionist opens the patient's computer file by entering demographic data into the system. The patient is instructed in the use of the CRT and completes a brief screening test (Q1) which measures ability to undergo computerized self-report testing. If the patient fails the Q1 test and is judged to be in need of immediate inpatient care, he bypasses the remainder of the PAU assessment procedure and is evaluated later when his clinical condition permits. In the usual case, self-report testing is possible at intake, and the comprehensive assessment process begins. Self-report tests administered include: (1) the MMPI, (2) several tests of intellectual performance [consisting of the Shipley-Hartford screening IQ measure, a test of episodic long-term memory (TMPE), and the WAIS arithmetic subtest], (3) the Briggs Social History, and (4) the Beck Depression Inventory. As each test is completed, the computer analyzes the responses and prints a narrative report. A PAU interviewer administers a structured mental status examination and records data on a CRT. Upon completion, a computer-derived narrative report of the interview, including a psychiatric diagnosis, is printed. The PAU coordinator reviews test reports and

completes a structured problem list on the CRT. He designates specifically relevant problems from a dictionary of precoded problems and rates the severity level of each problem designated. Based on this problem list, an optimal initial treatment disposition is determined.

A formal evaluation study was undertaken to compare the PAU system with the traditional admitting-physician approach to intake triage (Klingler, Johnson, & Williams, 1976; Klingler, Miller, Johnson, & Williams, 1977). While some data analyses are still being completed, the available results strongly support the conclusion that the PAU system results in superior assessments that have a positive impact on treatment outcomes and decrease the cost of patient care. Furthermore, patients report that they prefer the computerized evaluation system to the traditional approach.

The PAU represents a positive innovation in mental health care delivery. On-line computer technology has been integrated into the operation of a comprehensive mental health treatment program to improve patient care. Evaluation studies have shown that the PAU system is highly successful at this enterprise. Not surprisingly, then, a number of mental health service delivery agencies have expressed an interest in implementing systems similar to the PAU.

However, few mental health agencies have currently installed computer facilities (Johnson, Giannetti, & Nelson, 1976). Of those who need to purchase data-processing equipment in order to implement a PAU system, few are able to make large capital expenditures. The initial PAU data-processing system was programmed on a Control Data 3200 system consisting of a processor with a 131,072-character memory, three disk storage units with on-line storage capacity of 24,600,000 characters, three magnetic tape units, a communications multiplexor, unit record I/O, and 16 CRTs. This is an expensive system to purchase (more than \$500,000), to program (more than 10 man-years), and to maintain (about \$35,000 per year). Few mental health agencies can afford this expenditure.

Because of the great expense of the Control Data system, we decided to implement the PAU on a microcomputer system, the PDP-11V03. The purposes of this paper are to describe: (1) the PAU system developed on the microcomputer, (2) some of the advantages of the approach taken, and (3) some of the limitations and difficulties encountered during implementation. It is hoped that this information will be helpful to others considering development of an on-line assessment system on a microcomputer.

HARDWARE AND SYSTEMS SOFTWARE

The PDP-11V03 is manufactured by the Digital Equipment Corporation. Our particular system configuration includes the 11/03 central processor with 4,000 words of memory, the extended arithmetic option, expansion chassis and power supply, an Intel 24,000-word memory board, the RXV-11 floppy disk system (512,000 bytes of storage), a VT-52 CRT, six VT-50 CRTs, an LA-180 printer, and the RT-11 operating system. The cost of this system was approximately \$26,000. The yearly maintenance fee is less than \$4,000.

Systems Design

All programming was completed under contract with a local software concern in multi-user BASIC and MACRO-11 using the RT-11 operating system in single-job mode. RT-11 was modified to enable use of the LA-180 printer. This modification involved the installation of a null modem in the interface and changes to the printer driver. Assessment programs for questionnaire presentation, scoring, file updating, and report generation were written in BASIC. These programs were written in modules of approximately 2,000 words which are chained and overlaid. Each assessment program presents questions, collects responses, scores data, and prints interpretive reports. Utility programs for Intel memory diagnostics and for file maintenance were written in MACRO-11. All patient data are stored on one floppy disk, and all programs are stored on the other floppy disk.

One CRT is reserved as the systems terminal. The systems terminal is used to initiate the assessment system, register new patients, order reports on previously completed questionnaires, order activity summaries, delete patients from on-line storage, list patients on the system, and run assessments if necessary.

Six CRTs are dedicated as assessment terminals. A request for a patient identifier is presented at each of these terminals after the assessment system is initiated. When the identification number of a patient previously registered through the systems terminal is entered, a main choice menu is presented. Several options are available: "questionnaire," "status," and "next patient." Selection of "questionnaire" causes a menu of questionnaires to be presented. These include: the Q1, the

ShIPLEY-Hartford, the Beck Depression Inventory, the MMPI, and the problem list. Selection of one of these options results in the presentation of the appropriate questionnaire along with operator instructions. Once a patient completes a questionnaire, the program scores the data, stores scale scores on the patient disk file, prints interpretive results, and presents the main choice menu again. Selection of "status" results in a listing of testing that the patient had previously completed. Selection of "next patient" causes a request for a new patient identifier.

Patient data storage is sequential. The first block of 512 bytes is devoted to a patient index file. The social security number of each newly registered patient is recorded in the first open field on the file. The index position number provides the key to storage file look-up. A patient file consists of either one or two 512-byte blocks and contains demographic data and scale scores for each of the tests administered. Approximately 450 patient files can be maintained on-line using this scheme.

ADVANTAGES OF THE SYSTEM

The primary advantage of the microcomputer-based PAU system is that it is inexpensive. However, there are other advantages that have accrued. Vendor-supplied programming systems and file-handling routines are relatively simple to use. The equipment is small in size and portable.

The systems approach taken has several advantages for others considering a microcomputer for a similar application. It relies heavily on PDP-supplied software and, thus, involves a minimum amount of systems programming. Assessment programs are written in BASIC and are easy to program and modify. The disk storage approach is uncomplicated and easy to use.

LIMITATIONS TO THE MICROCOMPUTER APPROACH

We have discovered several limitations to this approach. First, systems throughput is reduced by the small amount of usable memory and slow seek times on the floppy disk. A large applications program such as the MMPI uses nearly 15 overlays. Test administration is delayed each time an overlay is called. However, early experience indicates that these delays are barely perceptible to the user who is responding to a questionnaire. Second, due to the small amount of disk space, on-line storage is limited. We are able to keep a maximum of 450 patient records on-line. Furthermore, the patient records are abbreviated to include only summary information. Third, file maintenance (e.g., transfers, merges, etc.) is difficult. Maintenance programs are written in MACRO-11 and are executed after the removal of the systems disk. All other applications must be forestalled during file maintenance. Fourth, the RT-11 operating

system lacks certain sophisticated features. For instance, if two memory resident programs call for the printer at the same time, the system does not automatically queue these requests. Manual intervention is required. Finally, no more than five terminals can be connected to the system, and response times are reduced when all possible terminals are in operation.

AVAILABILITY

Additional information about the design and operation of the system is available from either of the authors at the Department of Psychiatry and Behavioral Sciences, Eastern Virginia Medical School, P. O. Box 1980, Norfolk, Virginia 23501. Information about specific applications programs is available from Psych Systems, Suite 206, Medical Tower, Norfolk, Virginia 23507.

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