AD-A185 689 CONTINUOUS VIGILANCE SIMULATOR WITH REAL-TIME NEUROENDOCRINE CORRELATION(U) HARVARD MEDICAL SCHOOL BOSTON MA C A CZEISLER 30 JUL 87 AFOSR-TR-87-1232 1/1

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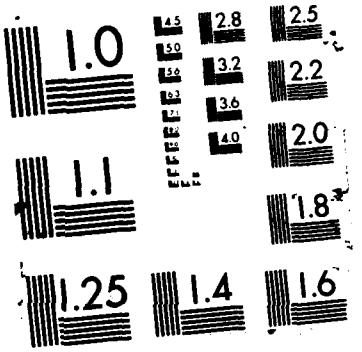
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"CONTINUOUS VIGILANCE SIMULATOR WITH REAL-TIME NEUROENDOCRINE CORRELATION"

12 PERSONAL AUTHOR(S) Dr Charles A. Czeisler			
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19 ABSTRACT (Continue on reverse if necessary and identify by block number)
A Continuous Electroencephalographic and Physiologic Monitoring System was configured using a VAX 11/750 control unit. The system combines three important and interrelated functions: monitoring the health and safety of human research subjects during long-term studies; scheduling and recording discrete events such as meal times, bedtimes, and performance test times; and collecting physiologic data from the subject.

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22a NAME OF RESPONSIBLE INDIVIDUAL WILLIAM O. BERRY	22b TELEPHONE (Include Area Code) (202) 767-5021
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The Continuous Electroencephalographic and Physiologic Monitoring System is a automated data acquisition system currently in use in the Neuroendocrinology Lab of the Brigham and Women's Hospital. It was completed in June of 1985, funded by Air Force Office of Scientific Research Grant no. AFOSR830309. The system combines three important and interrelated functions: monitoring the health and safety of human research subjects during long-term studies; scheduling and recording discrete events such as meal times, bedtimes, and performance test times; and collecting physiologic data from the subject. The latter function is the most demanding of the three, due to the nature of the research and the requirement that multiple channels of physiologic data be recorded in real time, automatically, continuously for up to several months, with great reliability, and in the case of certain electrophysiologic data, at high speeds.

To meet these demands, the system uses a Digital VAX 11/750 control unit. The VAX is optimally configured for this application, with two 456-megabyte fixed disk drives to permit storage and access of the large files created by high-speed data channels during long recordings. A floating point accelerator allows rapid statistical analysis of these same files on the same system. A laboratory peripheral accelerator preprocessor subsystem (DEC LPA11) handles the high-speed data acquisition channels through DMA interface with the main system, relieving the control unit of the highest frequency realtime tasks. The system has the capability to digitize eight different channels of electroencephalographic data on each of two different subjects at

two hundred samples per second per channel for eight to ten hours at a time, maintain the data on disk for computer analysis, display it visually on a CRT display scope, and transfer it onto tape for archival storage, while simultaneously carrying out all its other data acqusition, event control, and performance testing functions.

The principal data acquisition devices connected to the system are the ten-channel electronic linearizing thermometer and the two eight-channel electroencephalograph machines. The electrically-isolated thermometer records body temperature, which is the most important and reliable indicator of the status of a subject's circadian timing system. The EEG machines record brain waves, muscle tonus, eye movements, and cardiac pulse signals. These signals, during sleep, indicate the depth and quality of sleep, and during wakefulness they indicate the occurrence of unwanted sleep episodes or entry into states of consciousness other than full alert wakefulness. Both types of data are essential in interpreting the results of any human performance study, particularly one that designs to take into account the subject's sleep-wake cycle and its possible disruption by schedule changes, transmeridian travel, medications, changes in illuminance level, or environmental isolation.

The system is installed in the Environmental Scheduling Facility (ESF) of the Neuroendocrinology Lab. This facility consists of three separate study suites, each capable of housing a human subject, for periods of time ranging from hours to months, in a controlled environment. The suites are completely

sealed from outdoor light, are soundproofed to exclude noise, and are air conditioned independently from the surrounding building. Thus, subjects can be isolated from all environmental time cues when necessary. In addition, two of the suites contain wall-mounted banks of lights, each incorporating sixty eight-foot full-spectrum fluourescent lamps in an area of 112 square feet, capable of simulating the illuminance of outdoor sunlight. The three suites adjoin a common Control Room, where most of the instrumentation is located.

Integration of the Continuous Electroencephalographic and Physiologic Monitoring System with the ESF has created a powerful research tool for the study of the effects of schedule changes, environmental conditions, illuminance level, and other synchronizers of the human circadian timing system on human performance. Results already obtained in research using this facility represent significant breakthroughs in the understanding of human circadian physiology. One achievement of particular importance is the characterization of the human phase resetting curve to bright light, and the concomitant discovery of methods by which the human circadian clock may be rapidy and accurately reset for optimum performance in any time zone.

ITEM	VENDOR	MANUFACTURER	PURPOSE	TOTAL COST
		SYSTEM CONTROLLER		
VAX Computer system, including: - VAX-11/750 CPU - 2 MB Main Memory - RUA60 Disk Controller - Two RA81 456 MB Fixed Disk Drives - Two DZ11 Asynchronous 8-line Multiplexers - TU80 Magnetic Tape Subsystem - FP750 Floating Point Processor - LA120 Console Terminal - LPA11 Microprocessor Subsystem for high speed data acquisition and A/D conversion - Necessary cabinets, backplanes, and interconnect cables - VMS Operating System - FORTRAN Programming Language - Field Service during installation period (1 year)	Digital Equipment Corp. 235 Wyman St Waltham, MA 02154	Digital Equipment Corp. Waltham, Massachusetts	Real-time data acquisition, performance tasking, real-time event control, data file management, statistical data analysis, and graphic display generation	118,774.59
Four ERGO 325 Video Graphics Terminals	Source Associates 304 Compton Avenue Laurel, MD 20797	Micro-Term Inc. Fenton, Missouri	General-purpose terminals for programming, process control, data entry, and interactive data analysis	6,354.00
		SYSTEM COMPONENTS FOR PHYSIOLOGICAL AND ELECTROPHYSIOLOGICAL DATA ACQUISITION		
Two EEG 5208 eight-channel Electroencephalograph machines	Nihon Kohden (America) Inc. 1652 Deere Avenue Irvine, CA 92714	Nihon Kohden (America) Inc. Irvine, California	Recording of electroencephalographic and other electrophysiological data relating to sleep, alertness and state of consciousness	18,690.56
PTL101 Ten-channel Electronic Thermometer with Power Supply and two 4 1/2 digit displays	Alpine Instruments 34 Lodge Road Newton, MA 02165	Alpine Instruments Newton, Massachusetts	Recording of body temperatures (an important correlate of circadian physiological status) and environmental condtitons	3,258.00

Initial Software Development for real-time DA and event scheduling	Brigham/Beth Israel Medical Group 20 Kent Street Brookline, MA 02146	Brigham Beth Israel Medical Group Brookline, Massachusetts	Software developed in-house for specialized data acquisiton and process control applications	20,976 00

SYSTEM COMPONENTS FOR ANALYSIS, TRANSFER, AND DISPLAY OF DATA

P300 Line Printer with Controller, Cable, and Field Service during installation period (1 year)	S&S Electronics 150 Industrial Ave East Lowell, MA 01852	Printronix Inc. Irvine, California	High-speed text output and hardcopy graphic output	7,274 00
630API Letter Printer w/ Forms Tractor and Acoustic Cover	David Jamison Carlyle Inc 5700 Buckingham Pkwy. Culver City, CA 90230	Diablo Systems Inc. Fremont, California	High quality hardcopy output for report generation	3,373.53
Half-inch tape drive with DEC Q-Bus compatible interface	Digi-Data Inc.	Digi-Data Inc. (Cabinet - Zieco Inc.)	Tape drive compatible with other Harvard Medical School computer systems to facilitate interlaboratory data transfer	7,514 75
AutoLink 212A Modem	Source Associates 304 Compton Avenue Laurel, MD 20797	U.S. Robotics Inc. Chicago, Illinois	Remote data transfer	475 00

VIDEO SURVEILLANCE SUBSYSTEM

Two ITC48AS Low-Light Video Cameras With:	L. Matthew Miller Associates 48 West 21st Street New York, NY 10010	Ikegami Electronics Maywood, New Jersey	Remote video monitoring system for nonintrusive monitoring of subjects' well-being and apparent state of consciousness	3,070 79
Two EM1 Video Camera Lenses		Chugai International Plainview, New York		
Two PT27024P Pan/Tilt Units with Wall Mounts		PELCO Inc. Gardena, California		
Two TC1112 12-Inch Black and White Video Monitors		RCA Corporation Lancaster, Pennsylvania		

ELECTROPHYSIOLOGIC DATA REAL-TIME DISPLAY SUBSYSTEM

HP 1347A Graphics Display Generator	Hewlett Packard 1775 Minuteman Rd. Andover, MA 01810	Hewlett Packard Andover, Massachusetts	Viewing and analysis of digitized electrophysiological data	7,280.00
HP 1310B 19-inch X-Y Display Monitor	Hewlett Packard (see above)	Hewlett Packard Andover, Massachusetts	Displays output of the 1347A (above)	5,100.00
IEEE-488 (HPIB) Interface	Digital Equipment Corp 235 Wyman St. Waltham, MA 02154	Digital Equipment Corp Waltham, Massachusetts	Allows the 1347A to be contolled by the VAX unit	1,072.00

EVENT CONTROL SUBSYSTEM

Six Termiflex HT/30 Hand-Held Control Units	Termiflex Corporation 316 Daniel Webster Highway Merrimack, NH 03054	Termiflex Corporation Merrimack, New Hampshire	Serve as keypads for single-key marking and logging of events as they occur in real time	1,990.00
DZ11-C 8-line Asynchronous Multiplexer	Digital Equipment Corp. 235 Wyman St. Waltham, MA 02154	Digital Equipment Corp Waltham, Massachusetts	Allows the system controller to communicate with the event marker keypads	2,712.00
Two VT240 Video Display Terminals	Harvard University Office for Informational Technology 1730 Cambridge St. Cambridge, MA 02138	Digital Equipment Corp Waltham, Massachusetts	Displays upcoming scheduled events and subject status information for the on-duty technicians	3,990.00
			TOTAL ----------	211,005.22

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