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A Research Note on:

Data Acquisition System: A Computer-Based Temperature Collection Methodology

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ABSTRACT

The purpose of this paper is to describe the development and operation of the Data Acquisition System (DAS) used for temperature collection and data analysis in a controlled-environment test unit. The DAS has a microcomputer central processing unit and specialized analog/digital temperature probes providing constant data capture. This system provides numerical and graphic outputs in both paper hard copy and instantaneous screen images. All experiments are stored on standard floppy disks for archival purposes and are easily obtained in complete form. Data analysis of each experiment is provided in graphic form with temperature in the "X" axis and time in the "Y" axis. The DAS provides a labor-free method of data gathering that can be used in a standard research laboratory or in remote settings with portable power generators.

INTRODUCTION

Since the beginning of general research of any kind, the drive to obtain the most accurate data has been important to the scientist. Contamination of data may be caused by poorly designed experiments or studying phenomena that have been fractionated from other effects. When studying the effects of energy phenomena on an interior environment, the scientist must prevent disturbance of the tested phenomena or the results will not be accurate.

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In earlier experiments run in the Controlled Environment Test Unit (CETU) of the Interior Design program at the University of Illinois, Urbana-Champaign campus, data collection was performed with simple temperature collection apparatus (Sherman, 1977). There was no contamination of the data collection because the temperatures were collected remotely. However, because the system was analog, it was not automatic. The system was a cumbersome, four-probe design requiring constant vigilance to record incoming data. Essentially, the equipment was a four-circuit switch box, an analog meter that dumped its data into a chart recorder. The accuracy of the data was determined by "eyeballing" the data off the analog meter or transferring line information off the chart paper. It was very labor intensive.

Research in home energy conservation has always been a problem because of the complexity of temperature data collection in real home settings. Often people living in a house are paid to keep a constant record of the temperatures on chart recorders. Because these instruments were analog rather than digital, they required the "eyeballing" method. The collected data had to be transferred into other forms for final analysis. The process for collection was labor intensive and the analysis procedure was a long process allowing many opportunities for mistakes (Siviour, 1981).

Improving a similar type of home energy research required a closer look at the data collection methodology and phenomena under scrutiny. After concluding that the massive number of man hours and the limited number of temperature probes were the biggest hurdles, it was decided that shifting to digital temperature-monitoring devices would be quicker and more accurate. In previous laboratory research, the investigator assumed the role of systems integrator when several pieces of equipment were to be used. Often, the researcher and several assistants manually operated the collection devices. They would transfer the collected data from a chart recorder to a lab book and then to a data analysis program run by a computer. With the advent of the microcomputer, laboratories could develop precise data acquisition, analysis and presentation of the results at high speeds without sacrificing predetermined research design parameters (Dewey, 1983). Temperature data could be manually recorded in numeric fashion rather than "eyeballed" or interpolated from the meter face or chart paper. However, data still had to be collected manually and a constant vigil of the equipment was necessary.

While it may be a new direction for research in the field of interior design, the computer-based data collection system has been used for years in chemistry and biology laboratories (Fanali and Hornstein, 1983). Recent work by Orlandi (1983) implemented a Hewlett-Packard 9835-A computer. This system provides data acquisition, reduction and mass storage requirements. Accuracy is the major reason for using a computer in these activities. The systems are designed primarily for data collection and processing. They offer significant advantages in information management, storage and retrieval of data and results, control of measurement constants and security.

Sherman

In research by Sherman (1983), the collection process is fully automated by interfacing a collection methodology with a computer. This required a complete revamping of the existing equipment. The heart of the collection operation is a Central Processing Unit, commercially referred to as an Apple 2 Plus computer. The following list shows the additional hardware and software used:

- 1 disk drive controller card
- 1 analog/digital/digital/analog card
- 1 clock card
- 1 graphic dump card
- 1 80-column card
- 2 Apple disk drives, 5 1/4"
- 1 green screen monitor
- 1 color monitor
- 1 dot matrix printer
- 1 line surge suppressor with fan
- 1 temperature sensor interface
- 16 temperature probes

As a result of the complexity of the collection and editing tasks that are part of the computer program, PASCAL was chosen as the operational language. It allows complex commands and, ultimately, the creation of sub-libraries for the compression of the total program. The program is run on a double-disk operating system using two floppy disks and is interactive with both drives.

Program Description

The program is written in the configuration of a tree. The "trunk" of the tree is the Main Menu List (MML) and the sub-menus are the limbs. At the beginning of the program, the operator is presented with a Main Menu List (MML) that is divided into three parts: 1) Collection Data Menu, 2) Edit Data Menu and 3) Quit Program. To run an experiment, the operator chooses the Collection Data Menu. In the Edit Data Menu mode, any data collected can be recalled in either a digital printout, an X,Y plot graphic depiction or both. The Quit Program mode stores any collected or retrieved data for future use.

The Data Collection Menu (DCM) is a four-part configuration: 1) Increment Time, 2) Duration Time, 3) Start Collection and 4) Quit. To start any experiment in the DCM sub-menu, increment time is the first variable. The researcher may insert the amount of time that should occur between samples of collected temperature. After the

time increment is entered, the duration of the experiment has to be entered. In either of these modes, the time may be entered in either seconds, minutes, or hours. The program changes the entry into seconds so the internal clock can use the entered time in the smallest measurement for accuracy. Following the entry of the times, the program may be started by depressing any key on the computer keyboard.

The last command in the DCM is the Quit command. The secret of retrieving files in the future is there. After the completion of the elapsed time in the programmed experiment duration, the collection is stopped. The Quit command stores the files on the second disk for file memory.

The Edit Data Menu (EDM) is a five-part menu allowing the researcher to retrieve collected data. The first part of the menu is the command Entire Data Graph. This command requests the researcher to enter the file name and insert the proper disk in the second drive with the file. The program then creates an X,Y graphic plot of the requested experiment. Once the plot is completed on the CRT, the program asks if a hard copy printout is desired. If so, the graph is dumped onto the dot matrix printer.

The next command is the Zoom-In Data Graph. It works on the same principle as the Entire Data Graph command. However, it allows the researcher to look closely at a specific portion of the graph of any experiment file if a specific phenomenon must be examined. To operate this option, a start time and an end time within the duration of the experiment must be entered. As before, the computer plots out the portion of the file of the experiment in an X,Y graphic plot on the CRT and gives the option to print out a hard copy with a CRT graphic dump.

Another command in this menu allows the operator to get a catalog listing of experiments stored on any disk. This command is List Disk Catalog. With the Reprint Data Menu, any file can be loaded into the temporary computer memory and then dumped into the printer for digital printouts. This option also allows the creation of new disk files by pulling out existing files from various disks and combining them on one disk. The last command in this particular menu is the Quit command. It gets the operator out of the Edit Data Menu and allows for movement back into the Main Menu List.

SUMMARY

The development of a computer-based Data Acquisition System enables the researcher to more accurately collect data in digital form. The DAS also frees the researcher from time requirements allowing more freedom to identify and focus on future problems. Specialized computer activities such as the X,Y graphic display and the zoom option to study unusual phenomena enrich the final data analysis by making the findings clearer. In these phases alone, large amounts of time can be saved.

REFERENCES

- Dewey, C.F. Multiprocessor system shifts data acquisition into overdrive. *Industrial Research and Development*, 1983, 25 (5), 112-115.
- Fanali, J.R. and Hornstein, J.V. Lab automation system guides chromatography information handling. *Industrial Research and Development*, 1983, 25 (8), 82-86.
- Orlandi, R.D. et al. Development of a testing procedure for a guarded hot box facility. *ASTM Special Technical Publication 789*, 1981.
- Siviour, J.B. Houses as passive solar collectors. *Energy Conservation in Heating, Cooling and Ventilating Builders*. 2, Washington D.C.: Hemisphere Publishing Corporation.
- Sherman, M.P. The effects of interior drapery on heat transmission. *Journal of Interior Design Education and Research*, 1983, 9 (1), 3-7.