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Current Computer Facilities in the Speech Research Laboratory¹

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Abstract. This report describes changes and new developments of the computer software and hardware in the Speech Research Laboratory for the period from 1990 through 1995. Our computer environment has slowly changed from a mainframe to a distributed architecture. Workstations in a Client/Server environment, configured to perform specific tasks have become better and more economical tools than our older Mainframe/Terminal configuration. We outline here the core of our computing facilities and describe some of the more important computer software. New systems described include the Local Area Network, a new Perceptual Testing System, a Speech Acquisition Program, new stimulus preparation and signal processing capabilities, and a cross-modal perceptual testing system.

The Speech Research Laboratory at Indiana University has created a unique environment for the study of virtually any aspect of speech. We have expanded and improved many areas of our computer facilities in a continuing effort to provide the necessary tools to conduct and explore this research. Because many changes have occurred since our last report (Bernacki, Feaster, Hernandez, & Forshee, 1989), we will briefly detail here some of the more important hardware and software development efforts. Additional information on specific aspects of any of these systems may be obtained by contacting our laboratory.

The major change in our computing environment has been the migration from a DECnet networked VAX/VMS mainframe to a local area network (LAN) supported by a central Novel Netware server with personal computers as clients. As a result of this move, we can now take advantage of the personal computer for word-processing, statistical analysis, e-mail, and other desktop applications. This change has allowed our researchers to configure and tailor their personal computers according to their specific needs. In addition, our workstations can devote more of their processing time to their specific tasks, since they no longer need to support the load of personal accounts.

Although we continue to support our VAX/VMS workstations for speech processing and stimulus preparation, we have expanded our capabilities by introducing two UNIX workstations. The new workstations are equipped with analog-to-digital converters that allow digitization from various sources. In addition, we have installed software to perform more complex speech processing analysis than what is available on our VAXes.

Over the past few years, we have developed a PC-based perceptual testing system (PTS) that has replaced our PDP-11/34 (Hernández, 1994). We are currently implementing the last phase of this project (Hernandez, Carrell, Reutter & Bernacki, 1992) and hope to have the system completed by the end of 1996. Various other software utilities developed in this lab for the purpose of digitizing and preparing stimuli have been ported or rewritten to accommodate new file formats and hardware.

A new direction in research has led us into the development of an auditory and visual experimental control system (see Hernández & Marcinkovich, 1996 (this volume)). This system gives us the ability to present digital audio and visual cross-modal stimuli and record reaction times very accurately.

Local Area Network (LAN)

The most significant change in the lab since our last report is the implementation of a Novell Netware LAN. Each person's personal computer can be networked and can perform work much like a non-networked computer. An important difference, however, is that laboratory staff can access files from more than just their local drives while still running the operating system of their choice. The Netware server coordinates all of the computers and regulates the way they share network resources.

Currently there are two servers. One handles everyday desktop needs, and the other handles file-sharing for our PTS system (Hernández, 1994). The desktop server is a 486 33MHz PC-compatible with 16MB of RAM and 1.2 gigabytes (Gig) of disk-space running Netware 3.11. Users can access this server from their desks using either PC-compatibles or Macintosh computers. Other clients are several specially equipped personal computers located throughout the lab. The desktop server also supports three laser printers and a DAT backup device available to anyone in the lab. Commercially available PC and Macintosh software is licensed and maintained centrally, making it easier to keep track of and update. Electronic mail and internet access are also available from each client. Machines that are not directly connected to the server can still access its files using FTP.

The other server is a 100Mhz Pentium computer with 32MB of RAM and 1.2 Gig hard disk and CD-ROM. This server acts as a file-sharing system for our PC and Macintosh perceptual testing system. It runs Novell Netware 4.11 and supports 32-bit addressing from its clients. Experiments that require accurate measures of timing intervals are unable to use stimuli from the LAN directly. In these instances, files need to be copied to each individual client.

Perceptual Testing System (PTS)

This PC-based experiment control system is a replacement for the aging PDP-11/34-based real-time systems used in our laboratory (see Forshee & Nusbaum, 1984). The old system has become virtually nonexistent in terms of both hardware and software. Furthermore, the architecture is 25 years old, and by modern standards, it is an extremely difficult environment in which to develop robust applications.

The current computers supporting our PTS configuration are 133MHz Pentium PC-compatibles with 16MB of RAM and 1.2 Gig hard disks. Each computer contains a SoundBlaster16AWE sound board, a timer board, a specialized parallel port and ethernet. A set of routines has been developed to control timing, presentation, and input into this system to perform perceptual experimental paradigms. For a detailed description of the hardware and software components of the set-up, see Hernández (1994).

Speech Acquisition Program (SAP)

To maintain compatibility with our new PTS hardware, we have ported a version of the Speech Acquisition Program (SAP: Dedina, 1987) to run on PCs. This program digitizes utterances into individual files under benign or manipulated speaking environments. The new program provides expanded visual and auditory cues; pictures in different graphics formats as well as auditory and character string cues are now available. Also, the program has the ability to measure reaction times from other inputs such as button-boxes or voice-activated keys with measures accurate within 3 msec. As the recordings are being made, the experimenter can monitor and control the presentation of cues. The program is able to repeat or skip cues on demand.

The hardware consists of a PC-compatible 486 with 8MB of RAM and 650MB of disk space. High quality 16-bit stereo recording is achieved with Tucker-Davis Technologies (TDT) System II hardware that can achieve sampling frequencies of up to 170kHz. The recordings are done in an IAC booth. In the booth, cues are presented with a 15-inch non-interlaced SVGA monitor and Beyerdynamic DT100 headphones. The microphone used is a Shure SM98.

Stimulus Preparation and Signal Processing

Our current VAX/VMS environment running the ILS package for signal processing and preparation has been useful over the years, but is also difficult to work with because of the lack of a good graphical user interface (GUI). To expand our capabilities, we have acquired two Sun Microsystems SPARCstation 5 UNIX workstations loaded with the Entropics Waves+/ESPS software package, giving us a broad range of analysis capabilities. The machines are equipped with 32MB of RAM and 1.2-Gig hard disks, using 19-inch color monitors and CD-ROMs. Also, each has a 16-bit 44.1kHz A/D and D/A converter for digital sound capabilities.

In order to take full advantage of this new hardware, we have begun to update and port various in-house software packages previously developed on our VAX/VMS computers written in C and Motif. Among the programs ported, the most important one is Mwaves (Motif Waveform Editor). This program provides a user-friendly environment for precise and speeded waveform editing with improved abilities to tailor the entire display layout to specific needs. Editing capabilities have been expanded to add noise, insert silence, generate tones, measure waveform lengths, scale waveform amplitudes, and perform a few simple analyses. The modular design of this software allows us to easily add processing and analysis tools.

Cross-Modal Perceptual Testing System

Because of an interest in experimental perceptual paradigms that would present audio and visual (A+V) cross-modal stimuli with control over stimulus presentation and accuracy over latency measures, we have developed a digital system that supports such paradigms. The system was developed on a Macintosh Quadra 950 because of Apple's long history of robust A+V capabilities. A Radius VideoVision board is used to achieve real-time video capable of playing full-screen QuickTime movies, and a 40-channel input/output (I/O) card from Strawberry Tree is used for timed button-box response. The programs were compiled using CodeWarrior C compiler (see Hernández & Marcinkovich, 1996 (this volume), for further details).

Following our philosophy of maintaining compatibility with other laboratories, we have also constructed a system that supports stimulus presentation from various databases available on Laserdisc. This system has total control over the stimulus presentation but does not have the ability to measure reaction times. It consists of a 486-PC with 8MB of RAM and 250MB of disk space connected to a Pioneer LD-V4400 Laserdisc via the serial port. The output of the Laserdisc is routed to a Panasonic CT-2084 color video monitor for stimulus presentation while the audio is presented through Beyerdynamic DT-100 headphones. A collection of routines were developed in Visual C/C++ for ease of programming and software maintenance.

Summary

In summary, as technology and reasearch demands have changed over the years, so has the sophistication of computer software and hardware resources. Ideas and techniques are constantly being generated and re-evaluated in this type of enviroment, and research tools are continuously challenged. To meet these demands, we combine commercially available tools with in-house programs and spend a considerable amount of effort developing modular reusable code on each hardware platform to reduce development time.

References

- Bernacki, R.H., Feaster, D.M., Hernandez, L.R., & Forshee, J.C. (1989) Current Computer Facilities in the Speech Research Laboratory. *Research on Speech Perception Progress Report No 15*, Indiana University, Bloomington, IN, pp. 505-512.
- Forshee, J.C., & Nusbaum, H.C. (1984). An update on computer facilities in the Speech Research Laboratory. *Research on Speech Perception Progress Report No. 10*, Indiana University, Bloomington, IN, pp. 453-462.
- Hernandez, L.R., Carrell, T.D., Reutter, J.G. & Bernacki, R.H. (1992). A new PC-based real-time experiment control system. *Research on Spoken Language Processing Progress Report No. 18*, Indiana University, Bloomington, IN, pp. 243-253.
- Hernandez, L.R., Marcinkovich, C.R. (1996). An Auditory and Visual Experimental Control System. *Research on Spoken Language Processing Progress Report No.20*, Indiana University, Bloomington, IN, pp. 395-402 (this volume).
- Hernandez, L.R. (1995). Implementation of a PC-based perceptual testing system (PTS): A first milestone. *Research on Spoken Language Processing Progress Report No. 19*, Indiana University, Bloomington, IN, pp. 321-328.