# AN APPLIED PSYCHOLOGY LABORATORY: THE VISUAL AND ACOUSTICAL PERCEPTION STATIONS

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ABSTRACT The problem of an applied psychology laboratory is faced: the solution proposed consists in several independent intelligent perception stations, usable as stand-alone terminal or connected with a small personal computer. Possible implementations of the visual and acoustical perception stations are presented: visual and acoustical stimula of different features can be produced in a programmed way and reaction times can be easily monitored with microprocessor-based systems which are one order cheaper than the currently used machines.

## Introduction

The advancement of psychological knowledge is strictly related to the availability of newer and finer methods and instrumentation. As far as such methods and instrumentation for a particular process are at disposal, better definitions of "how" and "when" this process occurs will derive [1].

The understanding of phenomena depends on the possibility of freely working with an independent variable. Examples of this statement can be found in the acoustical and visual perception and this paper deals with two dedicated systems which can be easily programmed by the user and give readily interpretable results.

Requisites of such apparatus are the flexibility, to allow different tests, the possibility of quantifying and recording the results, the cheapness and the easiness of use, in order to allow possible applications out of research laboratories. Traditional equipments, as tachistoscopes, reaction timers, audio generators and so on do not satisfy fully or partially the previous requisites and cost not less than 8000 $.

The microcomputer revolution has resulted in definitively overcoming such drawbacks, since low cost, greatly flexible, portable stations can be developed.
Two different phylosophies have been followed since now in the research laboratories: a central time-sharing computer with several peripheral stations (University of Boulder, [2]) or several independent intelligent stations (Universities of Iowa and Florida [3,4]). The approach followed in this paper is of the second type, even if the connection of the stations between them or to a central computer is always possible using already implemented serial lines.

The reason of this choice mainly resides in the fact that the architectures developed are closer to those ones that will be of interest for routine applications.

The visual and acousticals stations have the following common features:

- Each station, microprocessor based, is independently able to monitor times and accuracy of answers, has a standard monitor program and can use a normal CRT as interactive terminal;
- If higher processing capabilities are needed, a personal computer (APPLE II) can be used as terminal: in this case higher level languages can be easily used.

## The visual perception station

The visual perception station is a small specialized videographic terminal, equipped with an application oriented software and few specific hardware features, and has enough power to be configured as a stand-alone station, connected directly with a printer if required. Otherwise, if more logical power is needed, it is also possible to connect the station with a host computer. The block diagram and the specifications are shown in fig. 1; a Z80 CPU, running at 2.5 MHz, controls every operation of the terminal, by means of software routines and some specialized peripheral chips.

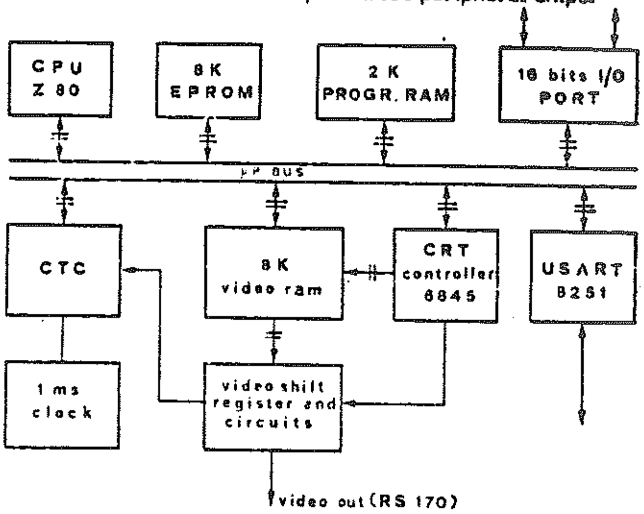


Fig. 1 - The visual perception station. Video format: 256x256 pixels - video standard: 64us/line, 50 fields/s, non interlaced - serial interface: RS 232c, 300 19200 Baud - display control: up to 20 s - timer range: 0÷9999 ms.

The program EPROM and RAM are much more than presently used, to allow future expansions; in fact, when configured as a stand-alone station, there may be the need of storing a substantial amount of experimental data to process them before printing, and also could be desirable to have more than one program for performing different experiences. The I/O port is a standard Z80 PIO, and is actually used to read the status of two push buttons, to syncronize commands depending on the vertical blanking time, and to blink the dot currently addressed according to an external clock. Another line is used to blank the display; all other lines are not used, and are available for future expansions, like a small, dedicated keyboard. A multiple counter-timer, a Z80 CTC, is used as a stop watch (with a resolution of 1 μs) for measuring external events (push buttons closures) and for counting video frames, i.e. display time. An Intel USART, the 8251, is used to communicate with the host computer or the printer via an RS232C interface, and, in the development stage, using a standard monitor program with a conventional CRT terminal: The video section is the most complex part of the machine; however, the recent availability of powerful but cheap LSI peripheral chips and the moderate access time required by this application have greatly simplified the implementation task. A dual-port, 400 ns 8K-RAM is accessed by the CPU or by a Motorola 6845 CRT controller; this chip, altough designed mainly for character-orientend CRT terminals, lends well itself to the realization of graphic terminals, when high speed, hardware graphic primitives are not needed, and is very cheap (less than 15 $) and readily available from distributors. The video format is widely programmable, and interlaced or not interlaced rasters can be generated; moreover the RAM starting address can be modified 'on-the-fly', to switch instantly from one page of display to another. Access contention to the video RAM has been solved simply by giving always the priority to the CPU; this approach is justified by the fact that in this application the CPU never accesses the RAM when the display is enabled, and thus the visual disturbances caused by the asynchronous CPU accesses are not visible.

As far as the software is concerned, a very modular approach has been followed and every precaution has been taken to improve the readability by other programmers, also if inexperienced, and to allow successive expansions and modifications. Functionally, the program is partitioned in five modules: 1) symbol table, where all the physical addresses are converted in symbol addresses (to free the rest of the program from specific hardware dependance) and the programming words for peripheral chips are collected; 2) initialization routine; 3) main program, with the command recognition routine; 4) specific commands routines; 5) utility routines, like multiplication, binary-to-ASCII conversion etc.

The commands actually implemented are the following:
A) cursor addressing (absolute and relative);
B) point writing and erasing;
C) vector plotting and rectangular area filling;
D) display load and dump by the serial port;
E) display control: on/off, time display (max 9999 frames);
F) timer control: push button activity.

This set of commands is oriented to the use with an external computer, like an APPLE; however, it is quite easy to write a specific experience program, using the commands as macro instructions, and store it in firmware in the station.

## The acoustical perception station

The acoustical perception station can generate either sinusoidal signals or phrases already recorded.

A microprocessor based board controls an hardware set-up (fig. 2) which is divided in two parts. The first part consists in a voltage controlled oscillator which can generate tones between 20 and 20,000 Hz, of lenght between 1 and 10,000 ms and of amplitude between 0 and 99 dB.

The features of the tone can be "single-frequency" or programmable, for instance as "swept frequency". The use of recorder is required in order to present predetermined sounds or phrases to people under examination.

A two-track recorder with remote control is used, where a track contains the phrases or the sounds of interest and the other track gives the coded markers which lead the microcomputer in the research of the programmed acoustical stimulus.

The whole system, as in the case of the visual station, can be connected with a commercial CRT terminal or to a host computer, if more logic power is needed. The emission of the programmed acoustical stimulus causes the people under examination to do some actions, thus obtaining the reaction time to the particular excitation.

The results can be loaded in the host-computer or displayed on a CRT or a printer. As in the case of the visual station, the ROM and RAM already implemented on the the board are not fully used, in order to allow the implementation of user programs.

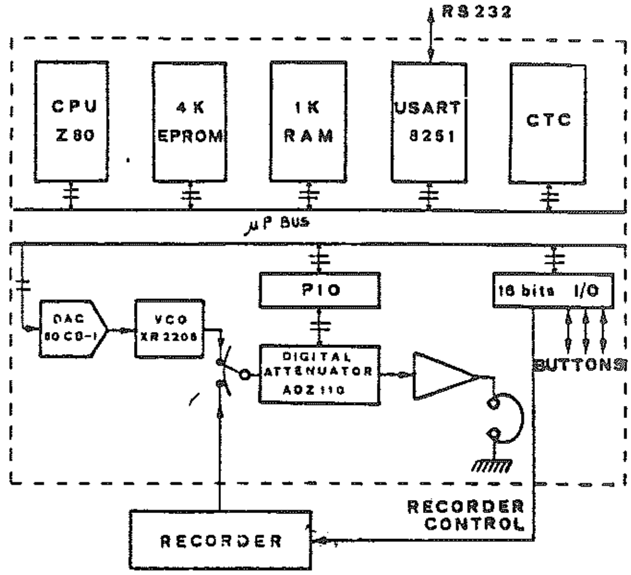


Fig. 2 - The acoustical perception station.

## CONCLUSIONS

A possible approach to a low-cost high performance applied psychology laboratory is presented.

The phylosophy of the whole design is to develop stations which are, at the same time, programmable by the user for research tasks and easily transformable to arrive to a firmware implementation for routine applications.

An easy-to-use hardware is also realized for the measurement of reaction time, which consists in a very simple keyboard.

Further developments of this research program will be the experimental choice of the most meaningful experiments which will be implemented in firmware for use out of research laboratories.

## REFERENCES


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