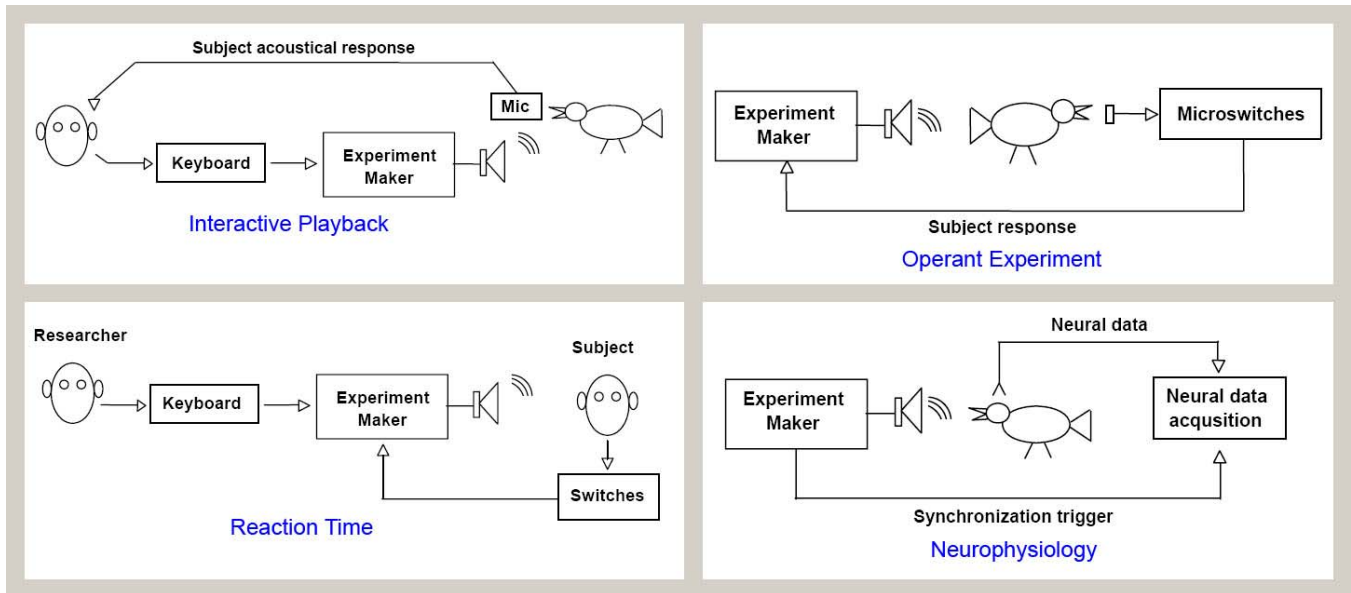# Experiment Maker™

Programmable presentation, measurement and control

Experiment Maker™ turns SIGNAL into a programmable, automated, real-time experiment control system by adding capabilities for simultaneous acquisition and playback, microsecond timing and triggering, digital I/O and keyboard control. With SIGNAL and Experiment Maker, the researcher can construct presentation, measurement and control systems that would otherwise require months of programming.

Experiment Maker provides tools for recording and presenting acoustic signals in real-time, precisely timing experimental events, interacting with human and animal subjects through digital switches and lights, and synchronizing with other systems through digital control signals. Applications in real-time behavioral, operant, and neurophysiological experiments include:

- Simultaneous acquisition and playback
- Precisely timed repetitive playbacks
- Adaptive playbacks
- Dynamic stimulus selection
- Reaction time measurement
- Automatic event counting
- Frequency measurement
- Trigger and pulse train generation
- Integrated acoustic and visual testing

Playback stimuli can be constructed and selected in real-time, based on any combination of stored stimuli, random selection, user input, subject responses and experimental conditions and triggers. Stimulus choice, subject response, and experimental conditions can be logged for later analysis.

Experiment Maker is implemented as an additional set of SIGNAL commands and is fully integrated with SIGNAL's analysis and programming capabilities. Analytically complex, automated experiments can be constructed as SIGNAL programs which combine Experiment Maker's interactive and real-time features with SIGNAL's analysis, execution, and programming commands.

Components

Acquisition and playback

Acquisition and playback processes can run simultaneously. They can be started and stopped under program or hardware control. They can be triggered by external processes for synchronization and sequencing, and they can trigger other processes in turn.

Experiment Maker can run an unlimited number of I/O processes simultaneously. These include acquisition, playback, digital I/O, and timing tasks such as timebase, interval measurement, and trigger or pulse train output.

Experiment Maker can run I/O tasks unattended in the "background" while in the "foreground" interacting with the user, performing calculations, and monitoring the background tasks.
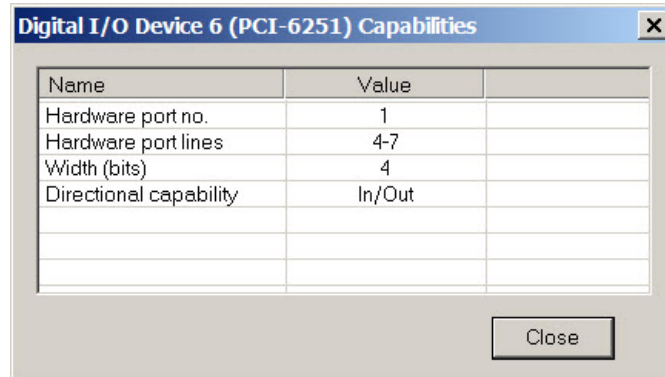
For example, Experiment Maker can launch a background acquisition process, then record experiment data, make time measurements on experiment variables, monitor subject response, store results on disk, etc. – all while the acquisition is executing.
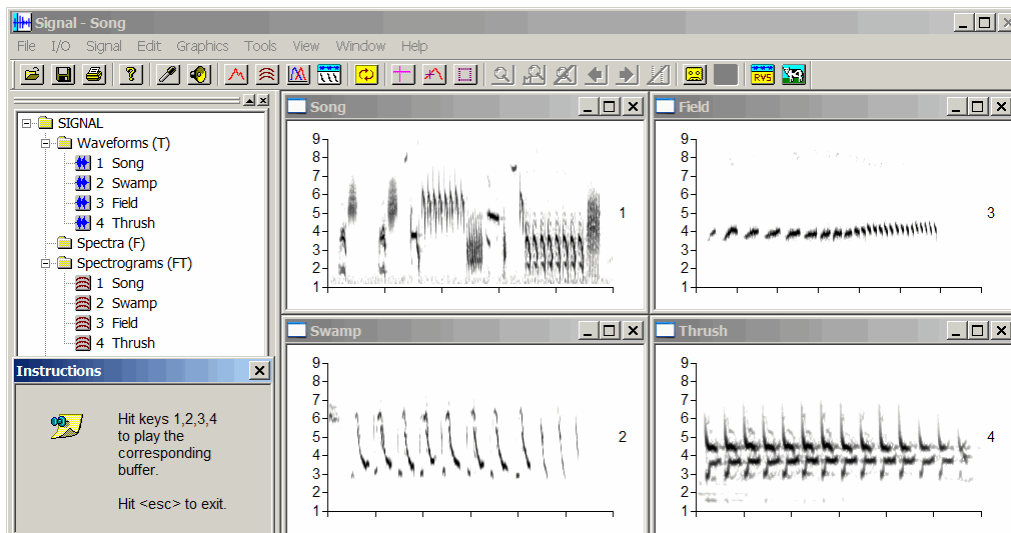
Digital I/O

Experiment Maker can read and write digital I/O lines, to interact with the research subject and synchronize or exchange information with external events and systems. Applications include:

- Switch visual stimuli on and off in a timed fashion in sync with auditory stimuli
- Read and time-log subject responses via microswitches or push buttons
- Receive stimulus synchronization signals from an external control system
- Control external devices such as programmable attenuators through digital outputs
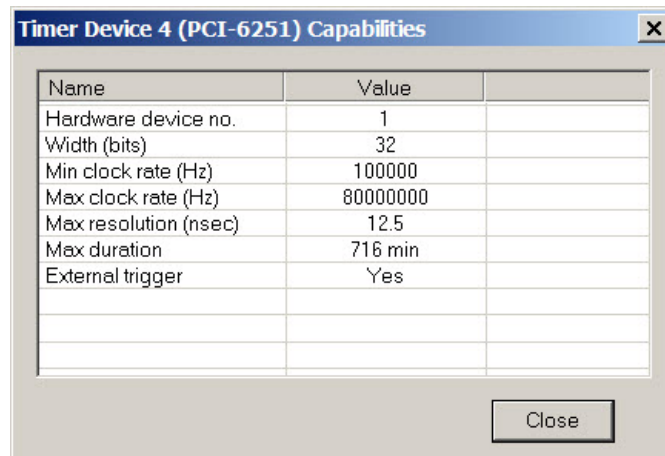
Digital I/O Device 6 (PCI-6251) Capabilities

Name	Value	
Hardware port no.	1	
Hardware port lines	4-7	
Width (bits)	4	
Directional capability	In/Out	

Close

Precision timer

Experiment Maker precision timer can timestamp events, pause for time intervals, measure time durations, measure frequency, count events, and generate triggers and pulse trains, with an accuracy of 0.01% and time resolution as fine as 12 nsec. The timing system can be used for the timed presentation of auditory stimuli and digitally controlled events and for time-stamping external events detected through digital input lines. Applications include:

- Reaction times
- Timed stimulus presentation loops
- Inter-stimulus intervals and chaining of multiple sequential stimuli
- Count and timestamp events (such as button presses)
- Synchronize multiple processes such as stimulus presentation and response measurement
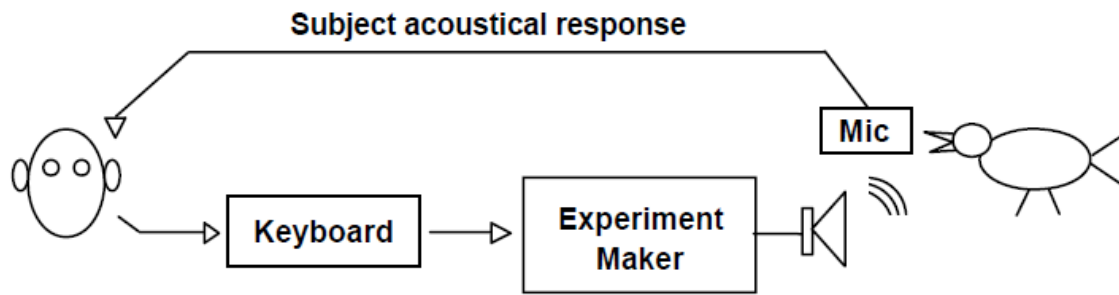- Control external systems via timed triggers and sampling clocks

Timer Device 4 (PCI-6251) Capabilities

| Name	Value	
Hardware device no.	1	
Width (bits)	32	
Min clock rate (Hz)	100000	
Max clock rate (Hz)	80000000	
Max resolution (nsec)	12.5	
Max duration	716 min	
External trigger	Yes	

Close

Sample Applications

Interactive playback

The researcher uses the keyboard to select an acoustic stimulus from a pre-determined stimulus set. Experiment Maker presents the stimulus to the subject. The researcher observes subject response and selects the next stimulus accordingly. Interactive playback allows the researcher to investigate perception by varying the stimulus in directed ways. The experiment can "walk" different dimensions of perceptual space (such as pitch, duration, repetition rate, and note order), mapping subject response along these dimensions.

Adaptive playback
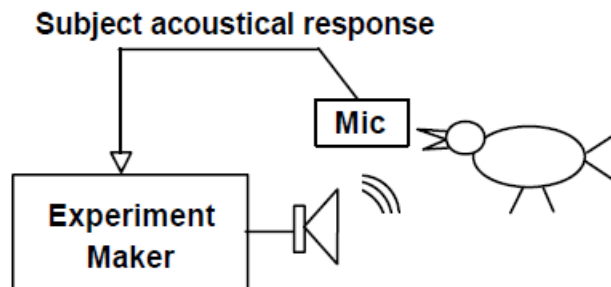
Experiment Maker presents an auditory stimulus and simultaneously records the subject's vocal response. After presenting the stimulus, the control program analyzes the response. The program might then either 1) select the next stimulus from a pre-determined stimulus set, using a programmed selection algorithm, or 2) generate the next stimulus parametrically based on pitch, duration, repetition rate, note order, etc., using an algorithm for varying these parameters. Adaptive playbacks are powerful because their automation can gather a large amount of data unattended, allowing the researcher to map many perceptual dimensions at fine scale.

Reaction time
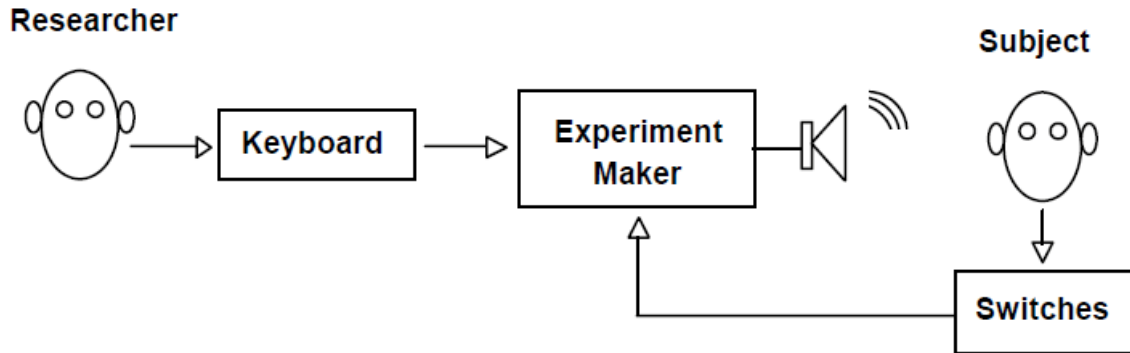
This configuration measures **reaction time**, which is the time between stimulus onset and subject response. The researcher selects an auditory stimulus using the keyboard, Experiment Maker presents the stimulus, records stimulus onset time, then waits for the subject to activate a switch signaling stimulus recognition. EM then records switch activation time and calculates the latency between stimulus onset and key press.

Operant testing
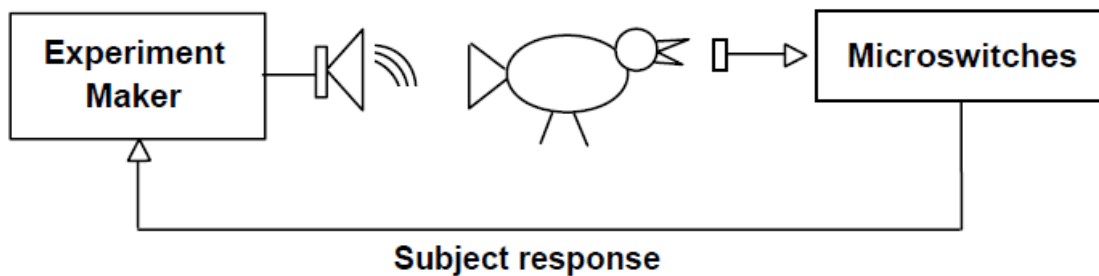
Experiment Maker presents an acoustic stimulus, receives the subject's response through digital switches, then selects the next stimulus by applying a pre-determined algorithm to the subject response. Experiment Maker records stimuli and responses in a log file. The entire process proceeds automatically, without intervention from the researcher.

Human subject test station

Acoustical stimulus
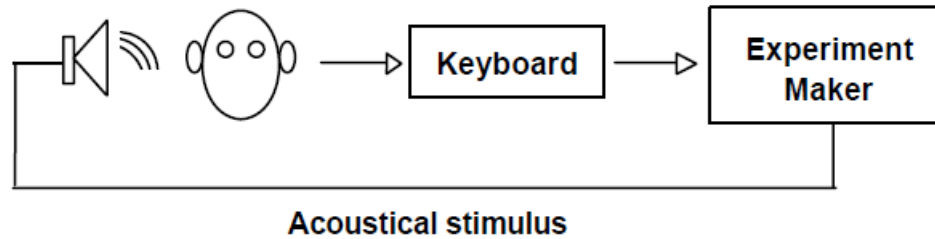
Experiment Maker presents acoustic and/or visual cues to a **human subject**. The subject responds via the keyboard (such as key presses or menu choices). The control program receives subject responses, varies stimuli according to a pre-determined algorithm, and records experimental results.

Neurophysiological stimulus delivery

Synchronization trigger
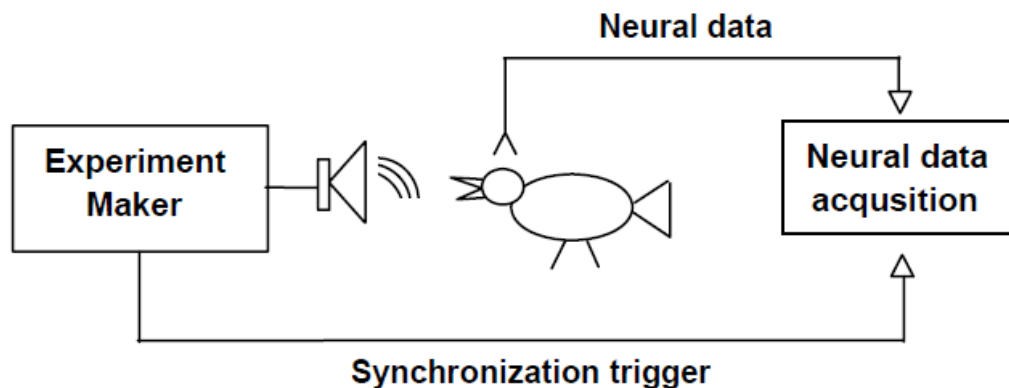
Experiment Maker (EM) is connected to a neurophysiology data acquisition and display system via digital control lines. EM performs stimulus presentation and the neural system gathers data and displays neural responses in real-time. EM selects or modifies stimuli and provides synchronization triggers to the neural system. EM can also transmit a stimulus ID to the neural system for entry in the neural data record.