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PART ONE: ELECTRONIC STUDIO EQUIPMENT

ELEMENTS OF A HOME STUDIO

What defines a home studio? How do you know when you finally have configured a home studio? Something as simple as a microphone and a cassette deck could be defined as a home studio, since you are at home capturing some sort of audio performance to a recording medium for later playback. However, a simple home studio such as that would give very limited flexibility indeed.

Let's define a home studio as a dedicated space within your home where you can capture the performances of multiple instruments or vocalists (either all of them simultaneously or individually at discrete instances in time) to some sort of recording medium, manipulate the live or recorded sound in some fashion in either the time domain or the frequency domain (I'll explain this shortly), combine them together in some relative fashion to achieve a desired effect, and then transfer the final result to some other medium for later playback. We can also define a project studio as simply a home studio that is used for and possibly by *others* to achieve the same results as defined above. Let's dissect this paragraph one element at a time.

The Dedicated Space:

At best, this might be a spare bedroom, the garage, the basement (if you are lucky enough to have one), the attic, or maybe even a small shed or building out behind your house. At worst, the "dedicated space" might be a section of your living room or family room (i.e., look at the inside cover of Todd Rundgren's *Something/Anything* album). If you share a living space with others, this arrangement of using the living room as your studio space generally does not work amicably for very long. The idea is to get a space that can be dedicated and arranged to support the particular requirements of recording audio.

Capturing Performances:

In order to capture performances, several critical items must be present. First, you will need some musicians or "the talent." The people that you record may be playing traditional acoustic instruments, singing, and/or possibly playing electronic, amplified instruments. Some electrical instruments can be connected directly to the equipment in your studio while others, along with the acoustic instruments and the vocalists, will need to be recorded using microphones. Microphones are simply the reverse of speakers. They convert acoustic sound energy into an electrical signal that can be recorded. The performances you capture might consist of a group or ensemble of players and singers, all playing at the same time. Obviously, this would require multiple microphones in order to capture each individual performer's audio and retain the ability to exercise some control over how it is recorded and processed downstream. Or, the performance you capture

might just be you singing and playing different instruments one at a time to build up a complete musical composition.

The Recording Medium:

The performances you capture have to be recorded onto something, and that something is the recording medium. Currently, there are many options and formats for recording audio. Some of the options use magnetic media such as analog tapes (reel-to-reel, cassette), digital tapes (digital audio tape (DAT), PCM digital data on video tape) or computer hard disk drive platters and removable disks (Zip, etc.). Other newer options use optical disks such as the CD (Compact Disc), DVD (Digital Versatile Disk) and MD (MiniDisc) formats. These options will be discussed in more detail later in the book.

Manipulating the Live or Recorded Sound:

Rarely is a sound recorded directly to a recording medium and then played back without some sort of manipulation en route. There are several ways that a sound can be manipulated. It could have its time domain characteristics changed in some way. This is generally achieved when all or part of the sound is delayed in time. Some of the effects achieved in this way are echo, reverb, flanging, chorusing, phase shifting, detuning, pitch shifting, and harmonizing. Echo is a copy of the sound that arrives at a later time. There might be just one echo from a delay line, or there could be multiple discrete repeats. Reverb is a continuum of echoes that all blend together and die out over time. It is the effect you hear after a single handclap in a large auditorium. Flanging is a strange effect first discovered when playing back two reels of tape containing the same audio and then delaying one of the tape players slightly by pushing on the flange of the tape reel. It gives a soaring inside-out type of effect. Chorusing is an effect that makes one sound be perceived as two or more similar sounds. Phase shifting is an electronic effect where different bands of frequencies are shifted in time relative to each other, and it gives a motion or swooshing effect to the sound. Detuning is a similar effect to chorusing, where a slightly detuned version of the sound is added back to itself to give a fattening or thickening effect to the sound. Pitch Shifting or Harmonizing is a more radical effect than detuning. The actual pitch of the sound can be changed up or down by an octave or more. Harmonizers can provide multiple outputs, each with a different pitch that is harmonically related to the original pitch.

In addition to time-based effects, a sound can have its frequency characteristics changed in some way. Equalization, filtering, distortion/fuzz, noise reduction and excitation are examples of frequency manipulation. Equalization is the boosting or cutting of different frequencies within a sound to achieve a desired effect (e.g., to make a voice sound as if it were being heard over a telephone). Equalizers can come in any one of several different types including graphic, shelving, parametric, and semi-parametric. I discuss these equalizer types in more detail later. Filtering covers a broad range of effects which can remove high frequencies (low pass filtering - LPF), remove low frequencies (high pass filtering - HPF), remove just a band of certain frequencies (notch filtering), or remove from a sound all frequencies except for a band of certain frequencies (band pass filtering - BPF). Distortion and fuzz effects have been popularized by electric guitarists for decades. This effect changes the shape of the waveform of the signal (and therefore its frequency content), usually by chopping off the peaks and adding various harmonics.

Noise reduction changes the frequency content of the sound by removing or reducing in amplitude certain bands of frequencies within the sound in the hopes of also removing offending hiss, buzz, clicks, pops and other annoyances that creep into recorded sound. Exciters are used to add a spectral enhancement to the sound. They can make the sound appear to be brighter, clearer and more harmonically rich. Exciters are also called enhancers.

Finally, the sound can have its amplitude manipulated in some way. The volume control on a mixer or preamp is the most obvious example of this, but effects such as compression, expansion, limiting, panning, and noise gating are also examples of amplitude manipulation. Compression is an effect that allows a sound's amplitude to only increase at a certain ratio based upon the original amplitude of the sound. For example, with 2:1 compression applied to an input signal, the output signal will increase only 1 dB (deciBel) for every 2 dB increase in the input signal. This helps to even out the dynamics of a sound, such as when a vocalist moves toward and away from a microphone or when a bass player plays with an uneven dynamic style. An expander performs just the opposite function of the compressor. For example, with 1:2 expansion applied to an input signal, the output signal will increase 2 dB for every 1 dB increase in the input signal. This helps add punch to a sound that has a limited dynamic range. Limiting is a more severe form of compression where the output signal is limited to a certain amplitude, regardless of how high the input signal amplitude becomes. Panning is the placement of a sound in the stereo panorama (i.e., left, right or center) by manipulating the relative amplitude of the sound in each channel. Noise gates cut off the audio signal when the amplitude falls below a certain preset level. This helps remove noise from the recording during quiet passages.

In my opinion, the first outboard boxes you should buy for your studio are a decent reverb, a stereo compressor and a stereo noise gate (in that order).

Combining Sounds Together:

Once all of these separate sounds are recorded to a medium with suitable processing and manipulation, they will need to be combined together onto another recording medium, so that other people will be able to listen to them and so that you can store them in their final mixed-down state. This function of combining the different sounds together is generally accomplished by a piece of equipment called the mixer (also known as a mixing console or a console). The mixer contains many little amplifiers inside, and each amplifier has its own volume control (also known as a potentiometer or a pot) and pan control that allows the sound engineer (that's you) to adjust the relative amplitudes and placements of the signals so that the final combination of the signals results in some desired output. This final combination of signals is then sent out of the mixer's main output to another recording medium to preserve that particular performance mix.

Any good audio mixer will allow a portion of the signal in each channel to be sent to one or more internal buses. These internal buses are usually called aux (short for auxilliary) buses to distinguish them from the mixer's main output buses. These portions of signals acquired from each channel of the mixer are called "sends", because they are picked off the main signal and sent somewhere. If they are picked off before the main volume

control for that mixer channel, then they are called pre-sends. If they are picked off after the main volume control for that mixer channel, then they are called post-sends. There are two main reasons for having sends on a mixer. The first reason is to create a separate and unique mix (also called a cue mix) of sounds for any musicians who might be monitoring through headphones. These sends are almost like having another whole mixer at your disposal. The second most popular use for the sends is to send portions of the audio signal out to external effects processors to further manipulate the characteristics of the sound. For example, echo or reverb can be added to the signal sends and then mixed back into the main mix on the mixer. These processed (or effected) signals return to the mixer through a different bus structure called (appropriately enough) the return bus or just the returns. The returns also have their own volume controls, so that just the right amplitude of effected sound can be added to the overall mix. In this manner, the listening experience of a complete sound stage can be recreated at the mixer output that contains all of the different instruments, the processing on their sound, the relative placement and amplitude across the panorama, and the required ambiance effects such as echo and reverb to give the mix a natural reverberant space.

The Final Result:

When all of the songs have been recorded and mixed down to stereo, they will need to be combined into one cohesive unit. This process is called mastering. Generally, mastering assures that all of the songs in the group hang together with a similar volume level, equalization level, and amount of compression. Mastering is also involved with the order in which the songs appear, the amount of silence between them and other aspects of recording finalization.

More about Project Studios:

I have used a simple definition of a project studio in this book (a home studio that is used for and possibly by *others* to capture audio performances), but there are more ramifications when you affix the moniker 'project' in front of studio. Your home's location may not be zoned for commercial business use, so neighbors might complain when they see a steady stream of people filing in and out of your house. And, they might be able to *hear* those people (pounding drums and bass, ripping guitars, screaming synthesizers, wailing vocals) in addition to seeing them, which might not help matters! If you work strictly solo in your project studio, then this probably isn't going to be a problem. Also, project studio owners need to be more involved in and aware of tax implications, depreciation of assets, insurance against loss, financial accounting and invoices, equipment maintenance, the physical appearance of the studio, and a host of other issues.

References:

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