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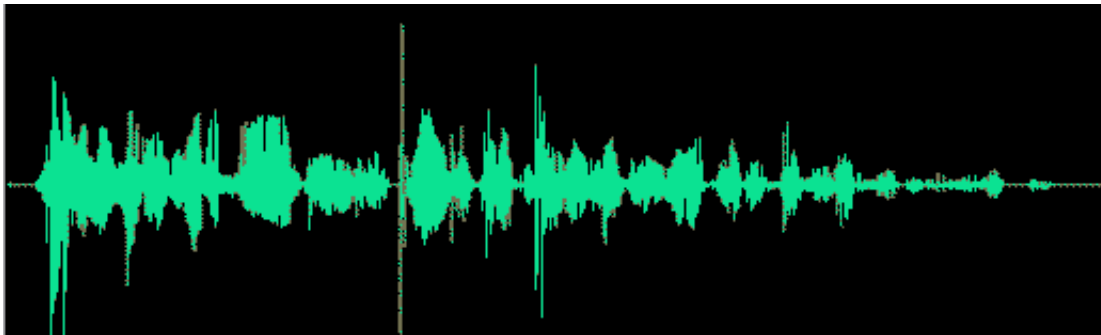# ieee·usa today's engineer online

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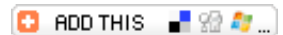> Editorial Info
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It's Not Just Digital
BY DONALD CHRISTIANSEN

I recently attended a meeting at which several first-year ECE students were present. Most of them, of course, had not yet encountered many, if any, electrical engineering courses. But I wanted to know what their interests were, and to learn how they viewed ECE at what was ostensibly the starting point in their careers. All of them, it seemed, were headed toward computer design or computer engineering. When I indicated some surprise at this uniformity of ambition, one responded "Today everything is digital, isn't it?" He seemed to express it less as a question than as a statement of fact. Almost all had been intrigued by computers from pre-grade school on. One had designed a Web site. Another had done some programming on her PC. All said they live with digital devices on a daily basis.

The meeting sessions were about to resume, so I had to discontinue my queries. Given more time, I might have asked about their familiarity with transducers, analog circuits, and A/D and D/A converters. I might even have succumbed to the temptation to lecture them on a favorite topic of mine — namely, that no digital system can live alone. After all, I would have said, every system, large or small, begins and ends with a physical thing, human or otherwise, that almost always offers some continuously variable input and output. In between input and output, I would remark, digital systems excel in processing and storing data, but their inputs must be encoded and their outputs decoded.

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short circuits

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Enter Analog

In the world of English majors, I would have reminded my captive audience, analog (usually spelled analogue) is not as strictly interpreted as it is in our realm. It may simply mean a concept or literary work that in some way loosely shares some aspects with another. But engineers expect a transducer, which I suppose might be called an A/A converter, to convert some physical aspect of light, sound, temperature, etc. to an electrical signal, some aspect of which (e.g., amplitude) is accurately proportional to the input's physical aspect of interest. I could then proceed to describe sampling and encoding that is needed to prepare the digital world to take over. After some secretive but commendable machinations it would disgorge an output that would be converted to an input needed and readily comprehended by a human or a machine.

As I contemplate the next step in my virtual lecture I realize how much I might have profited from the continued presence of my student audience. Perhaps we could have gone on to discuss other digital vs. analog issues — some merely philosophical but nevertheless thought-provoking.

My small student group would likely equate the term "digital systems" only to modern electronic digital systems based on binary integrated circuits. (So might many veteran engineers!) Historically, of course, digital systems in the broadest sense included a variety of items having information represented in discrete states — among them mechanical switches and beacons having only on and off states, Morse code having six discrete states, and electromechanical relay switching systems.

Ambiguities and Oxymorons

It seems that "analog" as used by circuit designers is usually equated to "continuously variable." But aren't there situations in which a digital signal could in fact be an analog (of a discrete state of some physical machinery, for example, as in the case of a production machine indexing to a new position)?

Some might even argue that the sequential excitement of the individual phosphor dots in a cathode ray tube represents a digital process of sorts, although the sweeping electron beam is clearly analog. If so, would the perception of a moving picture on the CRT screen that is made possible by the persistence of light emission from the phosphor (plus the perception of additional persistence by the human eye) constitute a digital-to-analog conversion?

Such academic discussions might help inform those youngsters contemplating ECE careers that there is more to "digital" and "analog" than meets the eye, and open vistas of specialization they had not thought of. Even those remaining committed to computer design would understand that much more than program design and writing code is involved.

Digital Personalities?

Someone recently remarked that we humans may have intrinsic digital or analog (linear) personalities. Interesting! If true, it could indicate our aptitude for certain specialties in engineering. What might be some clues to a person's leanings in the digital/analog divide? A writer preferring to type would be digital, one writing cursively analog. A pointillist painter (Seurat) would be digital, others (Manet, Degas) analog. A pianist, digital, a violinist, analog. A Sudoku fan, digital, a Scrabble enthusiast, analog.

I'll leave it at that. Someone may want to try for a grant from the U.S. Department of Education to pursue the matter. The findings might be helpful to the young engineering students I had quizzed about their ambitions. Perhaps one or more of them might even undergo a personal D/A conversion.

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