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My Vision Isn't *My* Vision: Making a Career Out of Getting Back to Where I Started

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J.K. Pulfer, 1971. "Man-Machine Interaction in Creative Applications."

Blame it on my stepbrother. It was around 1971. I was an undergraduate studying music, happily pattering around in the new electronic music studio at Queens University. Stan, on the other hand, had discovered computers. With that discovery came a missionary zeal.

I was not an easy convert. Perhaps this was the result of my being a preacher's kid. If my father couldn't convert me, Stan sure as hell wasn't going to. I just wanted to make music. Also, I couldn't imagine why I should care about computers, or what they could possibly have to do with music.

But then, my music composition professor, Istvan Anhalt, told me about a new project at the National Research Council of Canada (NRC 1970). It seems they were developing some kind of digital music machine. NRC was up in Ottawa, about a ninety minute drive from Kingston, where I lived. Still, Istvan's endorsement was not enough. That is to say, not even my respect for him was sufficient to get me to look beyond the electronic music studio that had become my second home. I had helped build it, I knew it, and I was happy there. Why not? I had never seen a computer. Why should I have had any reaction other than "So what?"

What tipped the scales – big time – was Mabel. Since I know you are wondering, Mabel was Stan's highly customized BMW R69S motorcycle. Now that was technology that I *could* wrap my mind (and the rest of me) around. Even music paled in comparison. The reality was, I lived to drive that thing. When Stan would let me, that is.

So here is how he made a believer out of me. If I would go to NRC and try out the computer music system, he would let me take Mabel back and forth to

Ottawa. With that as bait, I didn't hesitate for a second. Truth is, with that on the table, I would have gone up there to play a kazoo!

So, with Istvan's help, I made an appointment, and was off at the first opportunity. My life has never been the same.

When I arrived I was shown around an air-conditioned room with what appeared to be about eight whirring refrigerators in it. It turned out to be an SEL 840A computer with a phenomenal 8 kilowords (24K) of core memory! Sitting in the middle of all of this was a rather interesting guy, Peter Foldes. He was ensconced watching what appeared to be a pretty sketchy TV show. I eventually figured out that the "TV" was actually a graphics monitor, and what he was watching was a segment from a creation of his - one of the first (and still) great computer animated films, *La Faim/Hunger* (Foldes 1974, which won the *Prix du Jury - Court M trage* at the 1974 Cannes Film Festival and an Academy Award Nomination).

Interesting. So this thing can do animation as well as music. (See Burtnyk & Wein 1976.) Who would have thunk? My curiosity was piqued, and I started to pay attention.

Foldes had the day shift. I had graveyard duty. I would come in just as he was finishing, and then spend the night with my new mistress – the music machine. And in a week she and I finished the music for a film soundtrack – my ostensible objective in going up there in the first place.

So let me tell you about her – this beautiful music machine.

You can see her best half in Figure 1.1. At the console am I (with hair), writing music using common music notation, which is viewable on the graphics screen.



Figure 1.1: The Right Half of the NRC Music Machine

What you can't see is that the music could have up to four voices, each with its own composer-specified timbre. You could work on one melodic line at a time. On a second monitor above, the current voice was shown in one color and the other voices in another. (Red and blue – I can't remember which was which. The miracle, looking back, is that they had color at all.) To my right is an organ keyboard on which I was able to enter music in real time. And further to the right you can see a professional half inch Ampex four-track audio tape recorder that was under computer control, which enabled me to record my music – as it was digitally synthesized in real time.

Given that I only made the entrance requirements for piano the week before graduation, I did not use the keyboard much. Instead, I did something that I am often (wrongly) credited with being the first to do (as opposed to study): use two hands in graphical interaction.

Just to set the record straight, I picked up on bimanual input from what I learned at NRC. They picked it up from Engelbart & English (1969), who picked it up from Sutherland (1963), who picked it up from uncommon sense – his appreciation for what we do in the everyday world. Therein lies another lesson that I learned from my NRC experience: our most creative work usually turns out to be the recognition and subsequent refinement of other people's good ideas. There is honor in this, not shame, despite today's obsession with "original invention" (Buxton 2004, 2005b).

Getting back to NRC, Figure 1.2 shows me in the typical stance assumed in interacting with the system. Like in the system by Engelbart and English, my left hand is on a chord keyboard (see figure 1.3 for a detailed view). Each button specifies a certain note duration. From thumb to "baby" finger, the durations were: whole, half, quarter, eighth and sixteenth notes, respectively. If I pushed any of the buttons simultaneously I got the sum of their durations. Thus, if I pushed the buttons under my "ring" and "baby" fingers together, I entered a dotted eighth note. The toggle switch by the thumb enabled the mappings to be halved. If I pushed the button under my baby finger in this mode, for example, a thirty-second note would be entered. Finally, there was a larger diving-board type surface that lay under the palm of my hand. It was used to enter bar lines.

So much for the left hand and entering note durations. How about specifying where in pitch and when in time those notes were entered? This was done using the right hand, and there were two devices that one could use for this.

The first was the block of wood shown in figure 1.4. It was about the size of a bar of soap and had two wheels mounted at right angles underneath. It was a carbon copy of the original mouse made by Bill English for Doug Engelbart.

I didn't use it much.

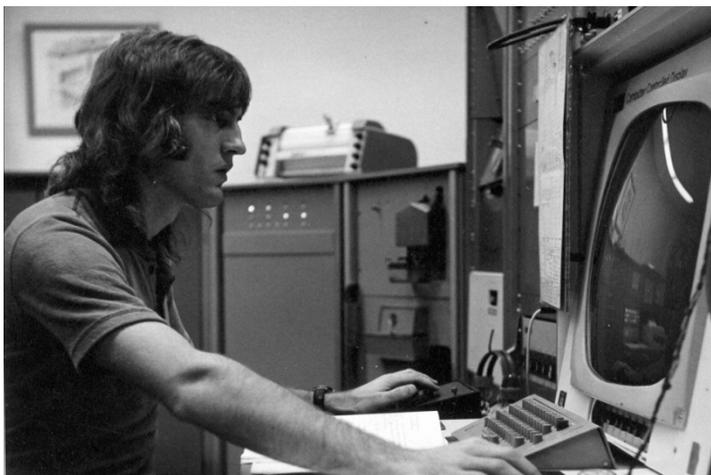


Figure 1.2: A two-Handed Graphical Input in 1971



Figure 1.3: The NRC Chord Keyboard



Figure 1.4: The NRC Mouse in use from 1968-1972.

For what I was doing, I preferred to use two large (circa six inch diameter) wheels that were oriented horizontally and vertically with just their edges exposed. In a way, they were like a big upside-down version of the mouse, but flush-mounted to the surface of the desktop. For those old enough to remember, they could also be described as a big version of the thumb-wheels found later on the Tektronix 4014 graphics terminal. For those who are younger, they were like a large trackball, but where one had fine-grained orthogonal control along the two axes - which is why I preferred them to the mouse. You can see the vertical wheel under my right hand in Figure 1.2. (My right thumb is simultaneously on the horizontal one – you just can't see it in the photo.)

With the horizontal wheel I could scroll left-right through time in my music, and with the vertical one, up-down to specify pitch. Pushing the chord keys entered a note of that duration at that point in time. As notes were entered, you could hear them synthesized through speakers connected to the computer, and at any time you could “proof-listen” to what you had written.

Along with all of this were full editing, recording, and printing facilities. To see many of the user interface features that I have described in action, see the short film, *The Music Machine* (NRC, 1971b). Now remind yourself when this was: two years before the first Xerox Alto, eleven years before the Xerox Star, and thirteen years before the Macintosh! Yet all of this functionality was within the grasp of a motorcycle-riding, mathematically illiterate (I still don't know calculus) hippie musician. After a few hours of coaching, I was able to comfortably work independently, and then needed only intermittent help to learn new features or to have some problem explained.

And that is the point, the wonder, and the importance. The system was designed from the ground up with technologically naive users in mind. Furthermore, there was constant involvement of expert users throughout the system's development. To the best of my knowledge, the only other examples of this kind of thing at that time came from Lincoln Lab (Buxton 2005b), and in particular, Ron Baecker's *GENESYS* system (Baecker 1969), which was built for animators. (Pretty good karma given my later and long-standing relationship with him.)

One thing that I want to emphasize is that the real objective of the system's designers was to study human-computer interaction, not to make a music system. The key insight of Ken Pulfer, who spearheaded the music project, was that to do this effectively he needed to work with users in some rich and potent application domain. And he further realized that music was a perfect candidate. Musicians had specialized skills, were highly creative, what they did could be generalized to other professions, and perhaps most of all – unlike doctors, lawyers and other “serious” professions – they would be willing to do serious work on a flaky system at all hours of the day and night.

I am convinced that the team that built this system knew more about HCI and designing for non-technical users in 1971 than most “professionals” did for the next twenty years. And yet, virtually nobody has heard about the system, or Ken Pulfer (1968, 1971). And, only a few have heard about Peter Tanner (1971, 1972a,b), who programmed a lot of it as an NRC student intern from Waterloo University.

There are reasons for this. The project published little, and what was published did not do a great job of capturing the real essence of what was there. Pulfer’s 1971 paper, “Man-Machine Interaction in Creative Applications,” for example, hints at it, but misses the mark. To me it gives no sense of the real impact that the system had on those of us who had the privilege and pleasure of working with it. Reading it today, I confess that had I not been there, I would not be able to appreciate its true historical significance either. But the work’s significance transcends the publications. For example, for any graphics or HCI student who has come out of the University of Toronto, this work is a significant part of their heritage – whether they know it or not. In fact, the music and animation systems developed at NRC provided one of the key catalysts to Canadian strength in HCI, computer music, and computer animation – and I certainly don’t mean just through me.

This was a golden time. My experience with this system surpassed even the motorcycle ride up to Ottawa – including those glorious hilly curves through the countryside. And given my relationship with Mabel, that is no faint praise. But truth be told, even this is an understatement. I am *still* striving to be worthy of the folks who gave me this, my first introduction to what has become my career. And, as the title of this essay suggests, since then, a huge part of my professional life has been an attempt to get back to where I started. My only hope is that I succeed. I at least owe them that. And the recognition. And thanks.

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