>> "OH, HUMAN FART"

"Man is a machine. A machine produced by evolution. I find it impossible to think that for mere nostalgic reasons, such a slime-based system would be preserved..."

Erkki Kurenniemi

> Erkki Kurenniemi (b. 1941), one of the great unsung pioneers of electronic art, is known in Finland as a versatile participant in many multidisciplinary projects—as a nuclear scientist, an inventor, and an artist—from the early sixties until today. In public, he has appeared on topical TV shows and written futuristic articles speculating about the future of mankind and the relationship of man and machine. He has been considered a prophet of artificial intelligence research, headband videos, artificial reality, you name it—often 10 to 40 years ahead of his time.
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> He is best known as the designer of a range of unique digital instruments in the University of Helsinki's Department of Musicology during the sixties. He subsequently had an impressive career as a pioneer of industrial automation at Rosenlew in the seventies, as an automation designer in Nokia's cable division in the early eighties, and as head of exhibition planning at the Heureka Science Center in Vantaa from 1987 to 1999.
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Framework invited Erkki Kurenniemi to write a sketch about his exploratory search for new types of user interfaces, and a short history of technical innovations from the early sixties to speculations about the future: what is it all actually leading to?
>
> *Erkki Kurenniemi* 040905 — 040908
>

>> ME & COMPUTERS

> This article is a short premature self-obituary, relating some of my activities with things happening in the world of technology, decade by decade.
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> FIFTIES > electronic music and the electronic computer
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> I was five when the ENIAC electronic computer was started. During the fifties, as a schoolboy, I read about computers and electronic music. Max Mathews used the computer to generate music. With my father, I visited the Bull computer factory in France, and I was sold.
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> SIXTIES > analog vs. digital
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> I started studying mathematics and theoretical physics and got my first job at the Institute of Nuclear Physics, programming an analog computer. Soon came the first digital computer, the Swedish-made Wegematic 1000, with vacuum tubes, a drum memory, and a thirst for kilowatts of power. At the same time, I had an unpaid job at the Institute of Musicology, developing their electronic music studio.
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> I read about the Buchla and Moog voltage-controlled synthesizers and started developing my own circuits, determined to learn the spiritual life of transistors and operational amplifiers. Voltage-controlled circuits are just specialized analog computing modules, and patch-cord patching is the natural way to program them, a technology borrowed from the old manual telephone exchanges and Hollerith punched card machines.
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> I began developing an integrated analog/digital music studio with combined voltage and digital control. Digital signals were used as triggers or gate signals, and also as square-wave sound. The final musical pieces were still edited the traditional way, by cutting and splicing analog full-track audio tape.

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> As integrated circuits became available in the mid-sixties, it was only natural to use them for memory and processing in sequencers and other musical instruments, but the main thing, a computer, was still unreachable to ordinary individuals.
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> I tried several "architectures" for pre-computer music instruments. At the 1968 conference on computer music in Florence, Italy, I read a paper entitled "The Music Terminal," presenting the idea of a graphic terminal, with local A/D D/A converters for a sampled sound interface, but still connected to a central mainframe.
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> SEVENTIES > computer on a chip
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> The first instrument in the Dimi series, the Dimi-A (for: Digital Music Instrument with Associative Memory) was constructed in 1970. It was a 2-channel non-processor digital sound synthesizer, with a serial MOS shift register memory of 100 16-bit words, built from about 200 TTL MSI circuits. Analog circuitry was only used for two 8-octave band-pass binary-selectable output filter banks, giving 127 timbral qualities for both channels.
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> The idea of an associative computer memory was attractive (alternatively known as a CAM, Content Addressable Memory). Most probably I got the idea from Teuvo Kohonen, the leading Finnish theorist in self-organization and neural computing. In the Dimi-A, all of its 16 bits circulated at high speed in their CCD or "bucket brigade" shift registers. Half of the 8 bits determined the time code for the instruction. Of the remaining bits, 4 determined the parameter, and 4 determined the value for that parameter. For example, a 4-tuple of 4-bit memory word nibbles (a, b, c, d) might mean: at bar a, at its beat b, set c (e.g. the pitch (mod 12)) to value d (e.g. #F).
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> This meant that to use the Dimi-A was to write machine code. That didn't turn out to be such a good idea.
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> The Dimi-A was followed by a series of Dimi instruments:
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>The Dimi-O was an electronic organ (with 1536 bits of MOS memory for 32 polyphonic steps) controlled by a video camera plus 1-bit video digitizer input and a 4-octave polyphonic keyboard.
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> The Dimi-S or "sexophone" was another user interface experiment. Four players, connected to the instrument by wires, touched each other and generated up to 6-voice parallel sequences, by repeatedly tapping each other's bare skin.
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> The Dimi-T or "electroencephalophone" was not really digital. Two clips at earlobes registered one component of the brain's electrical activity. The signal was amplified about a millionfold and filtered to eliminate all but the delta-alpha range of EEG. With some more processing the signal was used to modify the pitch of a voltage-controlled oscillator.
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> The last and the most unsuccesful Dimi instrument was the Dimi-6000. Intel had introduced the first fantastic "computer on a chip" or "microcomputer", and we obtained the first unit in 1972. The microcomputer-controlled synthesizer consisted of two subsystems: (1) the processor cards CPU, ROM, RAM, RS232 (for the display terminal), FSK modem (for C-cassette data storage), 8-bit control voltage DAC; and (2) the audio cards: VCO cards, VCF cards, analog multipliers for modulators, FET crosspoint switching matrices, etc.
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> Digelius Electronics, the company founded to manufacture and market digital instruments, crashed, and I moved to industrial robotics crashed. Jukka Ruohom ki, a Finnish pioneer of electronic music, wrote a sophisticated piece of software called DISMAL for the Dimi-6000. It was in effect a music assembly language. But then the world was not interested in code twiddling. It wanted to twiddle knobs instead and pound keyboards.
>
> EIGHTIES > personal computers
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> I bought my first Apple II computer in 1980, with a stupendous 32 kilobytes of memory. The built-in BASIC language was good for writing 'epic algorithmic art': simple sounds, graphics animation, and textual game-like interaction. Later came the Forth language, which allowed 'lyrical algorithmics', compact programs whose structure was more beautiful than their output.
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> The Midi interface arrived and changed the way music was made. The Midi interface (a local area network) and the Midi file standard introduced a new way to encode music, not as sound or as written notation, but as a real-time record of performer actions and gestures. The capacity of home computers was

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not yet sufficient for sampled sound.
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> I also considered Midi a tragedy for music. It bound us to an equal-tempered pitch scale for more than two decades. The computer would have been the first truly scale-independent musical instrument, but that chance was lost by bad formulation of the Midi standard.
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> For the 10th annual exhibition of the Dimensio group of experimental artists, at Kunsthalle Helsinki (1982), I constructed Master Chaynjis, the swearing robot.
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> It was a human-looking head rolling around the exhibition hall on two wheels, limited by an umbilical cable connected to the ceiling carrying power and serial data. It had four collision sensors at each corner of the base frame, and a limitless vocabulary speech synthesizer onboard. It performed a fractal-tree-shaped dance on the floor and every time it collided with a wall or a visitor's foot, it swore. The worst thing it said was something like: "Oh, human fart."
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> The aggression worked better than I had anticipated. Two days before the end of the exhibition, a religious fanatic was told by his god to destroy the swearing robot. The body of M. Chaynjis is gone, but his immortal soul is safe on a 5 1/4 inch floppy disk, waiting for resurrection.
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> The virgin era of home computers ended when the Macintosh appeared in 1984. Still too slow for sampled sound without extra audio cards, it nevertheless quickly established itself as the art machine No. 1. Windows later copied the Mac GUI, but Apple originally plagiarized it from Xerox Palo Alto Research Center, the place of magical alchemists who invented things like the personal computer, the mouse, the graphical user interface (GUI), the Ethernet, and the Internet, and later ubiquitous computing.
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> Computer games emerged as something more forceful than any previously known form of art.
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> NINETIES > Internet, mobile phone, laptop
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> It is too early to try to assess what really happened during the nineties. It has produced a kind of "Garden of forking paths."
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> The era of John Cage took over and ended with the ultimate composition: a stretch of stationary white noise at 0 dB level, starting at minus infinity in time, and going to plus infinity in time. Interestingly, some results in mathematics hint at the possibility that this grand random stream is unique! (Try Google "Bernoulli shifts").
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> The laptop emerged as the most amazing musical instrument to date, with sufficient computing power to generate anything a human ear could differentiate.
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> NOUGHTIES > present and future
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> The mobile phone will become the ultimate musical instrument. Networked from Bluetooth to the Net, it will again allow spontaneous jam sessions, global and/or local, with or without acoustic local channels. Music will return to one of its main roots as a form of many-to-many social group communication, freed from the strict chain of command God _ Composer _ Performer _ Audience.
>
> A message to Nokia. The keys of the mobile phone must be larger, with longer travel and pressure-sensitive, for music playing. And they should be all around the device. The phone also needs the 6D positioning sensors, with 3 spatial and 3 angular coordinates. A name for this generic instrument? Phonephone, phonyphone, or simply phone?
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> But still more ultimately, the hardware of musical instruments will disappear. Combining silicon acceleration transducers mere millimetres in size with Bluetooth-like wireless, possibly inserted into fingertip bones, will give all the manual dexterity ever needed and make mechanical things like mice obsolete. For visual perception, tiny video projectors, implanted inside eyeballs, will project images directly onto the retina. Both technologies need a good power source to be developed, such as an implantable biobattery extracting electrical energy (or ATP) from the surrounding living cells.
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> Very soon, LED-sized and -shaped (and -priced) video chips with integrated optics will literally cover all the walls and ceilings around us. Farewell, Orwell! "Privacy" will be an obscene word (it already is, in some circles). Cells isolated from their surrounding social control may develop into terrorist or cancer cells.

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> I keep on working with tonal music theory, in terms of whole number divisibility and simple numerical ratios, in the footsteps of Leonhard Euler (1707 1783). My present problem is to identify the triad chords in the divisor set of the "Donald Duck" number 345600 .
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> Having been mostly apolitical, except for slow drift from mild Zen-Marxism to still milder liberal anarchism, I now have a cause. The ideology of sustainable development is too slippery, because it does not specify absolute limits to change. I want to sharpen sustainable development into the Museum Planet Earth idea.
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> Briefly, this says that in step with the transhumanist fall into singularity, in less than 100 years, we should turn the planet Earth into a museum. This means an asymptotically stopped change in the resident human population, biodiversity, biosphere, environmental chemistry, climate, and so on.
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> But, everything will be allowed: economic expansion, population explosion because people will no longer age, genetic science and nanotechnologies of unimaginable power, warfare and worse, in space. A deal?
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> To make this Utopian future more acceptable, I shall briefly describe its econopolitics. In 2100, for example, print 10 billion "Earth licences" and distribute them to all the then-living humans. No more licences will ever be printed. Licences can be sold. This way, the people who want long life and long-lived children can have them, but only by migrating into space. This will be cheap, because there will be people wanting to stay down here, purchasing Earth licences at a price that will amply cover the price of the lift to orbit for the seller.
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