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Electronic Design and Microwaves & RF

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Enjoy Some Technical Tomfoolery to Celebrate April 1st

Check out our collection of annual April 1st issues for those looking for a bit of technical humor!

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ENDEAVOR BUSINESS MEDIA

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WILLIAM WONG, Editor
Electronic Design, Microwaves & RF

Vol. 5, No. 1

Top Stories from April, 2024

Check out our collection of annual April 1st issues for those looking for a bit of technical humor.

Welcome to our annual April 1st issue, where we try to bring some amusement and humor to an otherwise turbulent and wacky world. You can read and download all the stories in our April 1st Ebooks (below).

Traditionally, April 1st has been a time to celebrate with jokes, spoofs, and other tricks. Taking time to laugh can be difficult with all the other problems both personal and global, but hopefully it makes dealing with these a little easier or at least improves your outlook on life.

Each year we collected a number of new stories from editors and readers. They touch on familiar topics like quantum computing and IoT along with analog and power topics in a twisted fashion. We hope they will not confuse new readers too much, as our regular fare is designed to inform and educate readers about real technology rather than our whimsical machinations.

Image: Dzmitry Ryzhykau | dreamstime | 115899450

BILL SCHWEBER, Contributing Editor
Electronic Design

Startup to Introduce AI-Enhanced Analog ICs

Even classic analog components may get a functional boost due to the incorporation of artificial intelligence.

Artificial intelligence (AI) is apparently everywhere, but thus far has eluded use with basic analog components. (Somewhat ironically, certain AI systems are using analog components for the implementation circuitry in addition to aiding analog-IC design, but that's a story for another time.)

It all may soon change, though, thanks to a startup that hopes to develop analog ICs with AI-based enhancements (**see figure**). The company—tentatively dubbed AI4A ("artificial intelligence for analog")—said it will start with basics, such as the ubiquitous building-block operational amplifier, or op amp.

How will AI play into the op-amp function? The company's founder said that the AI-infused op amp will make intelligent decisions about what the input signal should be, based on experience, then substitute this value when the actual signal seems to be noisy, out of range, or otherwise corrupted.

In addition, if it senses op-amp "misbehavior" due to excessive common-mode voltage (CMV), offset drift, and other weaknesses, it

will automatically take action based on a combination of preset algorithms as well as the dynamics of the situation.

AI SPREADING TO ADCs?

Using AI to enhance analog functions doesn't end with this basic analog function. The company plans to extend the technology to more complex functions such as analog-to-digital converters (ADCs).

"The challenge is that the ADCs must quickly assess and digitize an unknown random signal from an unknown source, and this scenario can easily lead to errors," said the spokesperson. "Our AI-enhanced converters will know what the input signal should be and provide a digitized version that makes sense for the situation, if need be.

It isn't clear yet what the power or cost burden will be for these AI + analog devices. "That's a function of process, die size, yield, and many other factors, some of which are still unknown and others which we can't control," added the spokesperson. ••

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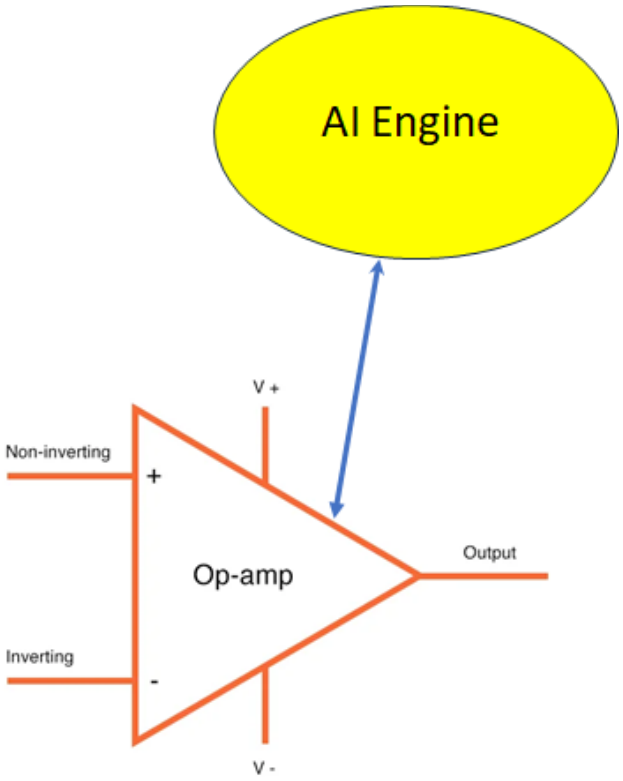

The details of the proposed AI4A (artificial intelligence for analog) device are still being worked out. However, the idea is to use an AI engine to supplement the basic analog op amp, which in turn could correct any signal gaps or inconsistencies. (Image source: University of Waterloo plus author)

Image: Susan Sheldon, Dreamstime

ALIX PAULTRE, Editor-at-Large
Electronic Design, Microwaves & RF

Urban Lifestyle Initiative is for the Birds

A group in New York City is working on a massive project to bring something back to the cities that hasn't been around for decades.

The highway of progress is littered with many casualties, as various technologies come and go, leaving their market and societal impact long after they have been rendered obsolete. These problems mostly stem from a loss of knowledge about how things were done previously, like a young person not able to operate a rotary telephone, or not know how a slide rule works. Some are lingering echoes of previous technology dominance that still impact the marketplace, like the legacy of fossil fuels steering energy policy.

A NOISY PROBLEM

However, one of the most impactful and terrible technological mistakes of the 1990s left almost indelible traces on every city in the U.S., as well as some other Western nations. The infatuation with loud and obnoxious car alarms almost destroyed the country, depriving people of peace and quiet and sleep. The sounds made by a car alarm were not only loud and shrill, they were sadly predictable, repeating on a regular basis anytime a car with one of the infernal systems inside was

disturbed in any way.

During the height of the car-alarm craze, it was impossible to live in an urban area not plagued by their constant and incessant shrill scream. Peace and quiet, already in short supply in cities, was nearly impossible to achieve for almost a decade. The irony was that the noise problem was so stark and painful, nobody cared if the car in question was being stolen or not. It was often vandalized by neighbors to get the damn thing to stop making noise.

One of the issues with the incessant din coming from these blighted cars was the warbling, changing nature of the alarm signal. Most mainstream units went through a series of cacophonous sequences in some vague hope of gaining notice beyond the insane alarm scream. The sequence ran through staccato bleeps, short piping toots, and siren sounds. It was an assault of sound that the poor people of most American cities had to live through and put up with.

THE IDIOCY ENDS, BUT PROBLEMS REMAIN

The slow migration to factory-provided alarm systems, and the adoption of the external functionality provided by car alarms like remote start and door operation, reduced the demand for car alarms to the point where they're a thankfully a scarce commodity in cities today. However, their evil impact on urban areas lingers to this very day.

One of the biggest issues with car alarms from the end of the 20th century was that as they made their terrible alarm sounds, they were imprinting the local birds. The loud tones in the morning were interpreted by urban birds as another, bigger bird with a song "sung" louder than theirs. Since birds compete with song, the city birds began to emulate the tone and pattern of car alarms—an unfortunate reaction that impacts how urban birds sound today.

Now, long after the car alarms with their annoyingly shrill sirens are gone, birds still mimic the beep-beep-beep and other sound patterns imprinted on them by the now-extinct noise machines. Unable to sing the songs they no longer know and never hear, much of birdsong in a city today reminds us all of the sad legacy of car alarms and their terrible noisy impact.

THE BIRDSONG INITIATIVE

A group of dedicated ornithologists and bird watchers have started the Birdsong Initiative, which they plan to roll out in every major urban center in the U.S. The plan is to put a huge loudspeaker on top of every building in a downtown area that plays birdsong constantly to condition the local birds to emulate real birdsong.

The leader of the group, Dr. Eno Lirpa, conceded in an interview that the program itself will be loud, but for a good cause. "Yes, for a year or so you'll have to listen to birdsong at 140 decibels, but at the end of that time, all the birds in your city will be singing a song instead of emulating an alarm sound."

When asked about the concern that not all birds sing the same song, and that the project will just exchange one pattern of sounds for another, he replied that at least it wouldn't be a car-alarm pattern. He asserted, "At this point, they could sing the Hokey-Pokey and I'd be cool with that. Anything would be better than that rotating cycle of car-alarm noises."

It will be interesting to see how the initiative is accepted by city dwellers, but it has high hopes. ••

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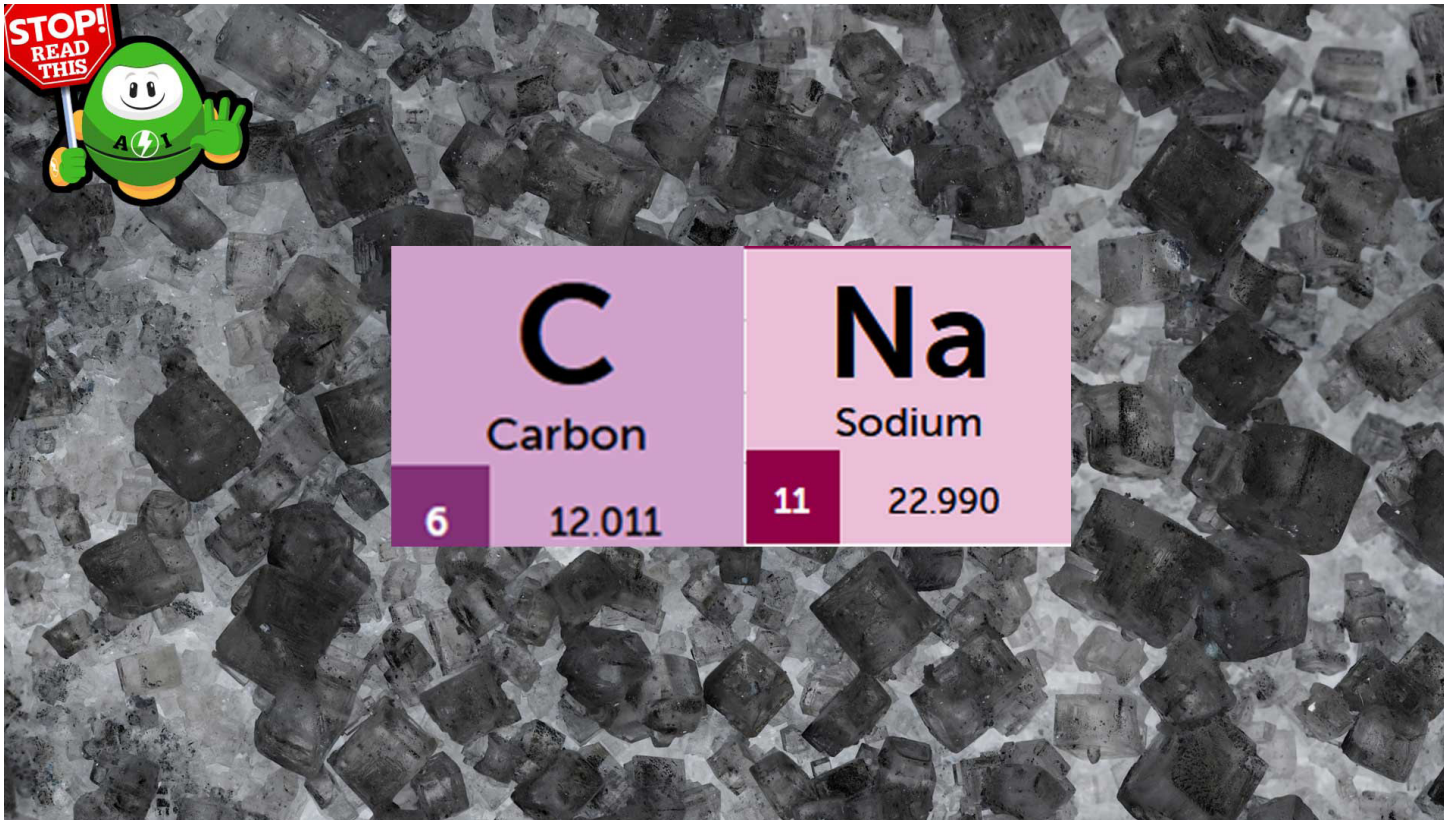


Image: Kittipong Jirasukhanont | dreamstime | 114674748

BILL SCHWEBER, Contributing Editor
Microwaves & RF

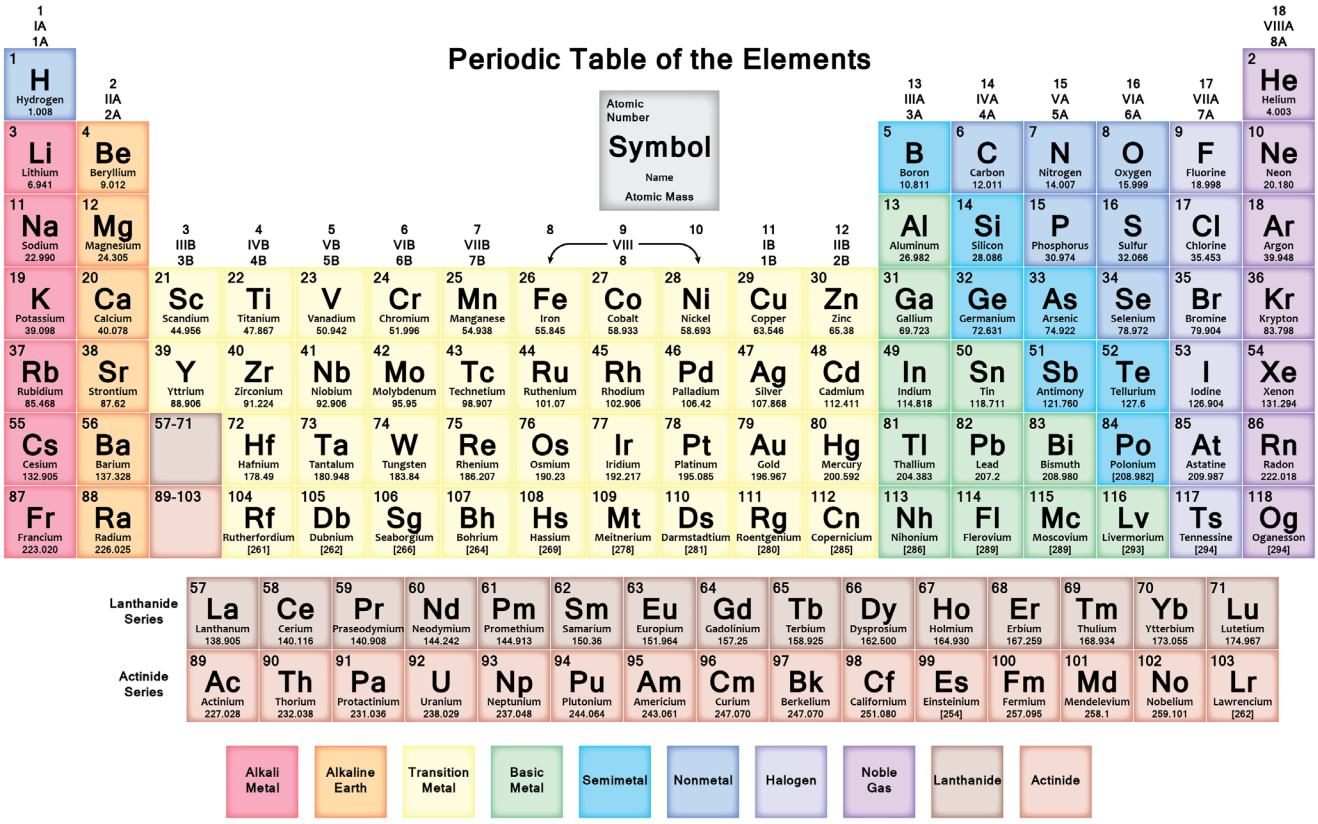
Elemental Carbon and Sodium Sue to Redeem Their Reputations

Two essential elements resent being maligned for the implications of their higher-level molecules.

Representatives of the recently formed Society for Elemental Justice (SEJ) announced that they're suing major media and related institutions for misuse of the basic terms "carbon" and "sodium" in place of the full molecule designations "carbon dioxide" (CO_2) and "sodium chloride" (NaCl). Speaking on behalf of these vital elements, SEJ says these elements are constantly being libeled and slandered when they're cited as sources of climate or health issues.

The spokesperson noted that "carbon" (atomic number 6, symbol C) is a vital building block for life as well as many industrial processes and products, whether it's seen as graphite, diamonds, or many other allotropic forms (**see figure**). Further, carbon is harmless in its elemental state. Sodium (atomic number 11, symbol Na) is also being maligned: The soft metal is somewhat hazardous in its pure state, yet needed for many scientific and industrial processes and products.

In other words, carbon is not an "enemy," nor is sodium. After all,



The periodic table of elements shows the position and facts about basic carbon and sodium, which are very different than their widely known associated molecules. Image: Science Notes

no one calls water "hydrogen"—short for hydrogen dioxide—and then says water is dangerous as both hydrogen and oxygen are explosive in higher concentrations.

That's why they claim referring to them as "carbon capture," "carbon emissions," and excessive "sodium" in the diet is actually inaccurate, casting aspersions and detrimental publicity on these two elements that serve so many roles in basic human life as well as industrialized society.

Representatives speaking for the two elements say that lazy journalists (at best) or ignorant ones (at worst) casually use the first half of the actual molecule name, without grasping the confusion it causes.

"It's like saying 'Joe' instead of 'Joe Smith' and thereby linking to all those people named 'Joe,'" said a society spokesperson. The spokesperson also admitted it wasn't clear what actual damage compensation would be demanded or could be expected, or where the suit would be filed.

Nonetheless, the spokesperson was adamant that these elements had the right to not be maligned and misrepresented, especially by those who wouldn't know elemental carbon or sodium if they ran into it either. "It's somewhat analogous to using 'microwave' in place of 'microwave oven,' but that apparently doesn't cause confusion as a result of the verbal context. However, it's not the same with carbon and sodium." ••

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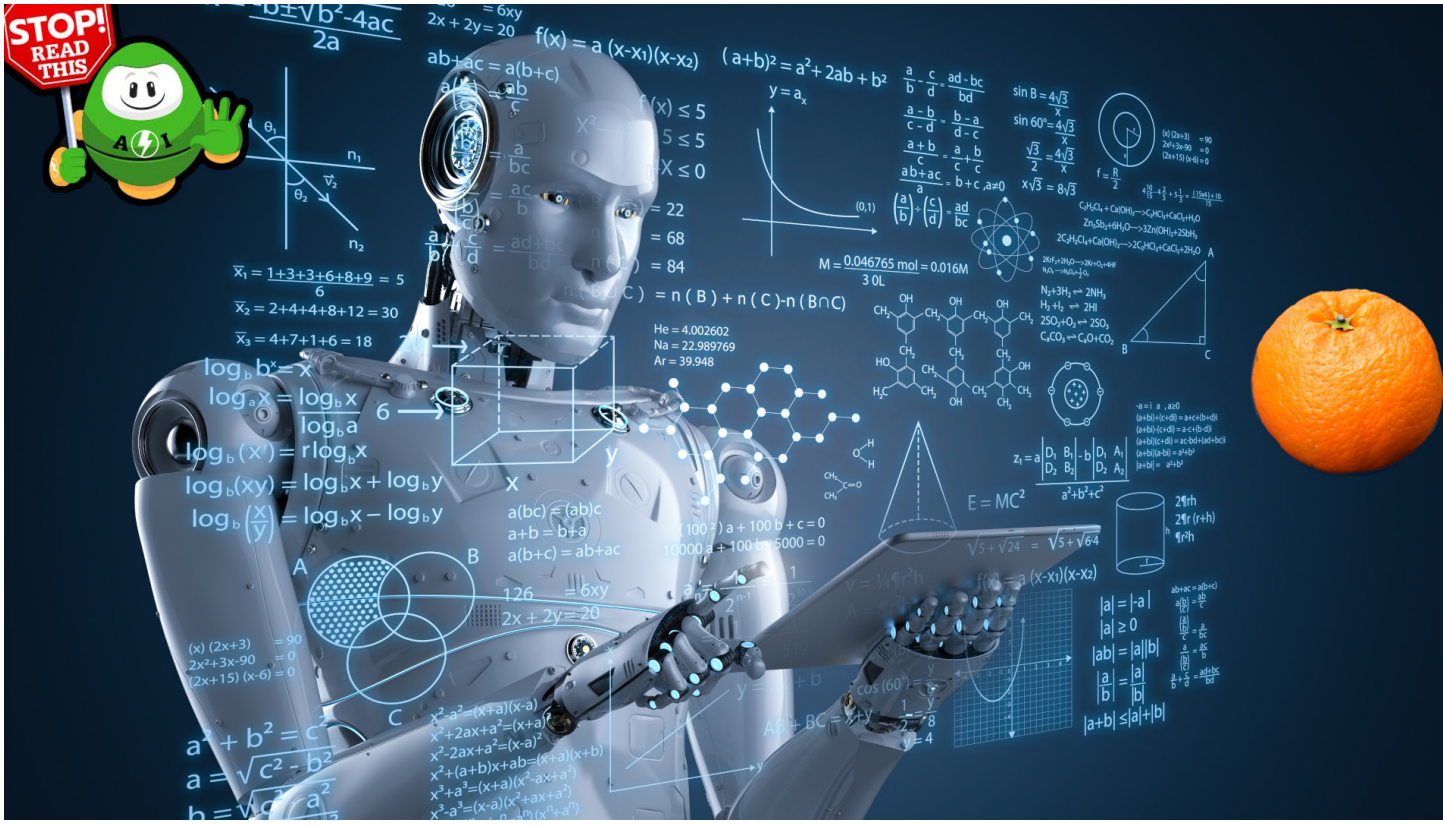


Image: Kittipong Jirasukhanont | dreamstime | 114674748

BILL WONG, Senior Content Director
Electronic Design, Microwaves & RF

Discovering Recursive Regenerative AI

RRAI takes a step past generative AI to a contemplative new paradigm.

Generative AI is all the rage and pushes past the trivial deep neural networks (DNNs) of yore. On the neural-network side, we have DNNs, artificial neural networks (ANNs), convolutional neural networks (CNNs), and recurrent neural networks (RNNs). Moving into the generative AI arena with large language models (LLMs), we have generative pretrained transformers (GPTs) and generative adversarial networks (GANs). Lately, we've seen the rise of small language models (SLMs) that are LLMs compacted to fit on smaller platforms requiring less computing power than a supercomputer.

The race to dominate the AI space has led to solutions like ChatGPT, Copilot, PaLM, Gemini, and LLaMa. These platforms require massive amounts of data and lots of computation resources for training.

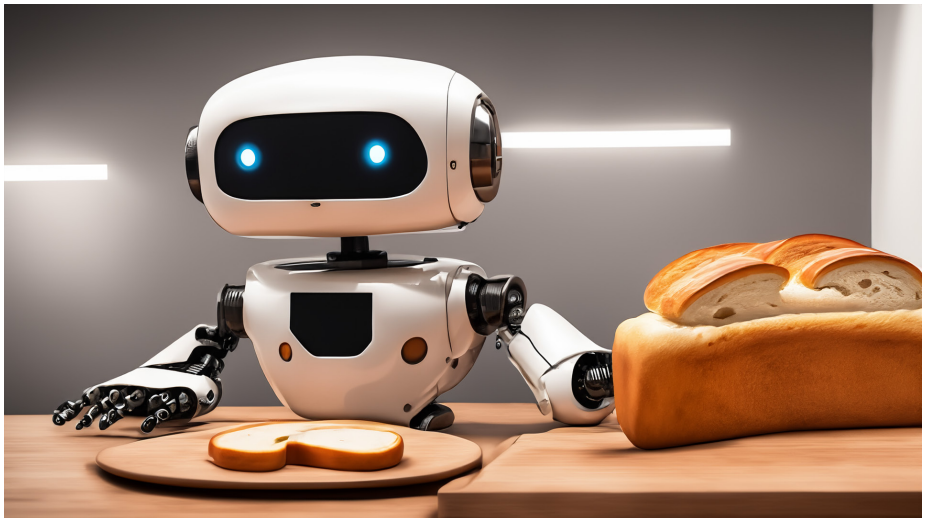
ENTER RECURSION AND SLICED BREAD

Recursive regenerative AI (RRAI) is designed to cut down the amount of data by operating recursively on details presented to it. It also

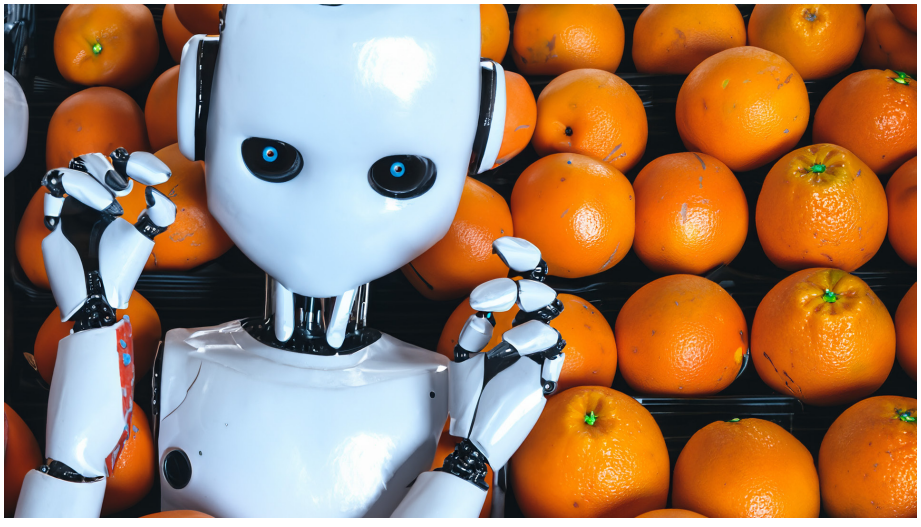
regenerates data to reduce memory requirements that nag conventional LLMs. This results in a significantly more compact solution than even SLM systems currently being employed or contemplated for embedded systems.

RRAI models can utilize bitmap arrays to provide additional data compression. The simplest case is a 1-Mbit array of all zeros can be compressed to a single zero. Most RRAI-trained models require an uncompressed array, though.

The quote "the best thing since sliced bread" comes to mind when looking at the RRAI improvements over LLMs. It turned out to be handy when generating our first robot (**Fig. 1**). The image was actually generated using conventional generative AI tools, but the robot is running RRAI to contemplate the bread.



1. Recursive regenerative AI-equipped robots can easily slice bread.



2. Robots contemplating their navel using RRAI sometimes results in images that aren't quite what we want.

CONTEMPLATING ONE'S NAVEL

The next step in RRAI evolution is still in the works. When prompted to contemplate one's navel, Adobe's Photoshop complained that it was against their rules, forcing us to utilize RRAI again. Unfortunately, the resulting image (**Fig. 2**) was not quite the navel we had in mind.

Instead, we turned to numerical calculations that could result in a better response from our RRAI-enabled robot. There are many questions that even quantum computers cannot address, so RRAI fills in a gap here as well.

The number 42 is the answer to the ultimate question of life, the universe, and everything according to the Deep Thought supercomputer in The Hitchhiker's Guide to the Galaxy. In our case, we just needed a recursive regenerative AI solution that delivered our result: 04-01-24. ••

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Image: dreamstime | Junichi Shimazaki | 101979624

BILL SCHWEBER, Contributing Editor
Microwaves & RF

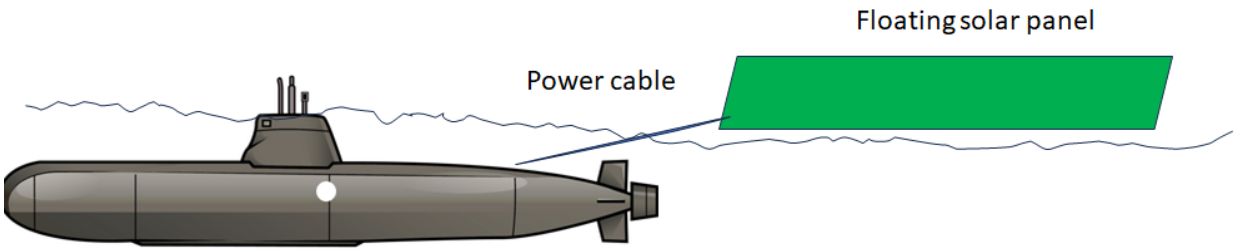
Navy to Evaluate Solar Power for Submarines

The nation's defense goes "green" by reducing use of diesel and nuclear fuel in submarines.

The U.S. Navy has announced that it will evaluate transitioning submarines to using solar panels as their primary power source over the next few decades. "We're very aware of the need to go green," said a spokesperson, "and this is a good place to do it," adding that "the present nuclear sources are effective but does create nuclear waste." Diesel submarines, which are used for shorter-duration near-shore patrols, will also be outfitted.

The subs will tow a large solar array, even when just below the surface (**see figure**). The array will contain AI-driven control surface to maintain orientation despite challenging sea conditions. If they have to dive deeper, the array will fold into a streamlined half-cylinder shape that will automatically be stowed on top of the hull, even under combat conditions. The same control surface will add to stability when submerged.

While the large solar array will degrade both surface and submerged performance, the Navy feels the tradeoff is worthwhile. "Climate change is an existential issue, and we are hopeful our enemies will appreciate that we are helping to do our part to mitigate it through the use of renewable



The towed solar panel is also functional when the sub is submerged just below the surface. (Image source: Pinterest plus author)

energy, even when they are attacking us or we are attacking them."

SOLAR SUB SIMULATION

Simulation and modeling for the new submarines will begin in 2024, with the first of the new "solar subs" expected to launch by 2034. If the program is successful, it will be extended to diesel submarines still used for shorter patrols. However, those subs have very different priorities and requirements for range and maximum dive depth. As an added benefit, the removal of the primary diesel power plant will ensure they're acoustically quiet.

The first solar-powered sub designs will be attack subs armed with torpedoes. Ballistic-missile subs ("boomers") and cruise-missile subs will be done in a second design phase, as their structures are more complicated due to the presence of top-side missile-launch tubes. ••

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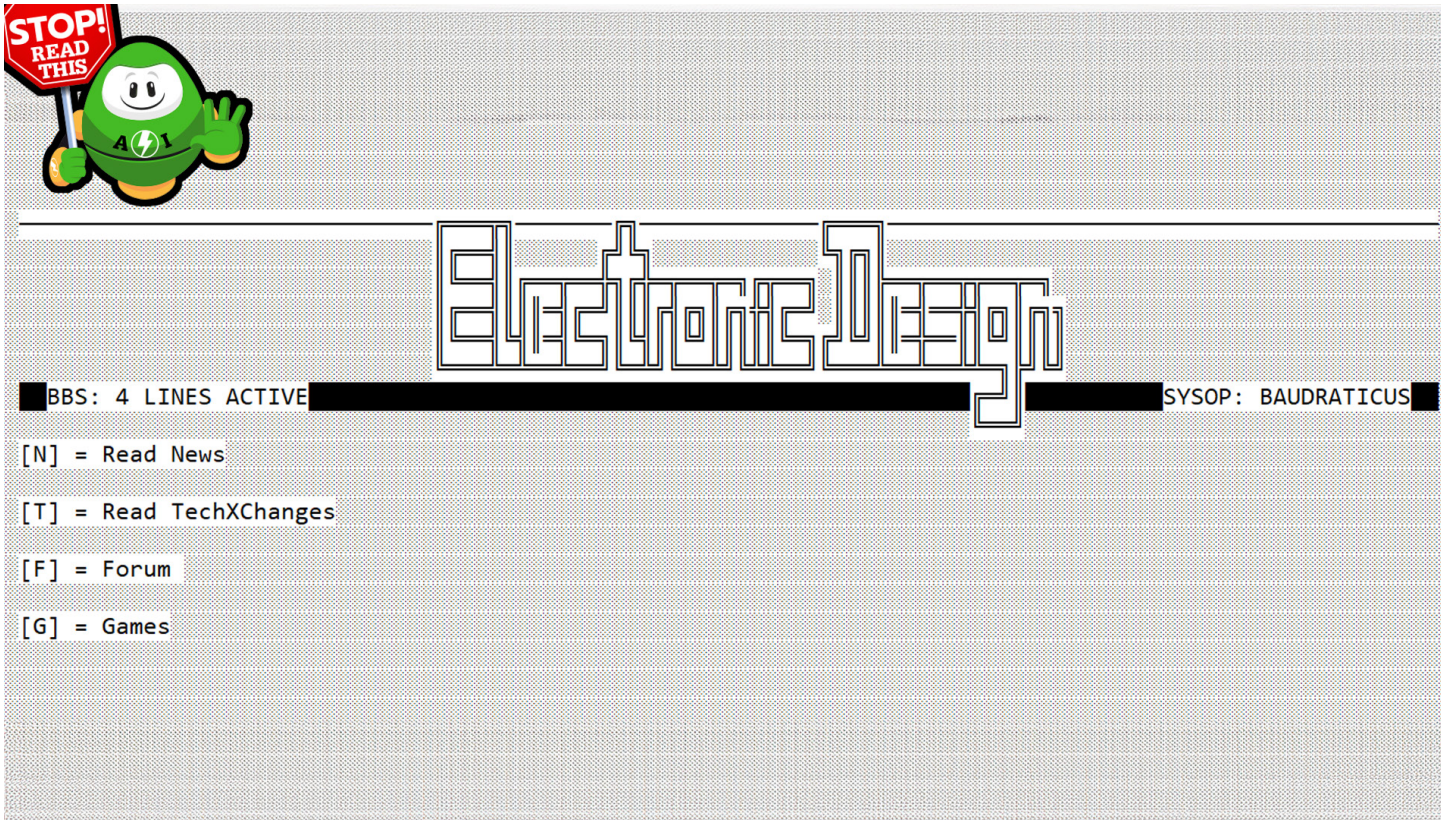


Image: Cabe Atwell | Electronic Design

CABE ATWELL, Technology Editor,
Electronic Design

Electronic Design's BBS Restarts After 30 Years During Catastrophic Website Outage

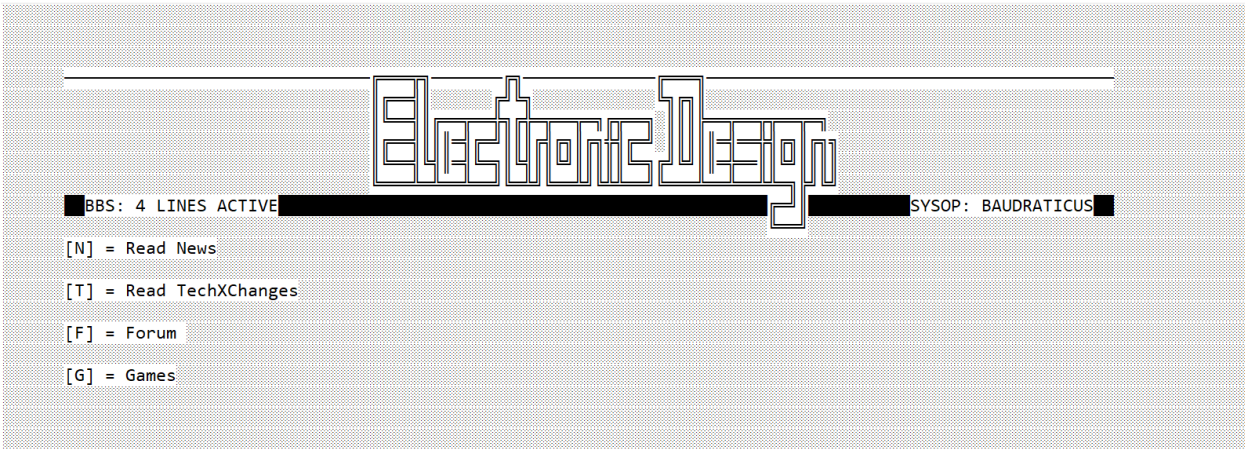
The original Electronic Design Bulletin Board System (BBS) is once again active after three decades of inactivity. Readers don't miss a single article,

At 2:45 am, Kip Johnson got "the call." He knew exactly what it meant at that time in the morning: "Fire up the BBS!"

It's been 30 years since Kip was that 11-year-old computer whiz kid, the only kid, let alone person, who knew how to use those new-fangled computer calling programs. He was always in charge of running the bulletin board system, a charge he never took lightly.

That's Bulletin Board System (BBS) for those who need a reminder. A pre-internet way of connecting to information and files through a dial-up connection and a modem, typically over a telephone line. They're run by System Operators, SYSOP for short.

I was asked to go and observe Kip. I sped right on over and met gleaming enthusiasm. I was let into a room of loud computer fans,



The Electronic Design BBS top menu. Simple, but it gets the job done the most efficiently. Cabe Atwell/Electronic Design

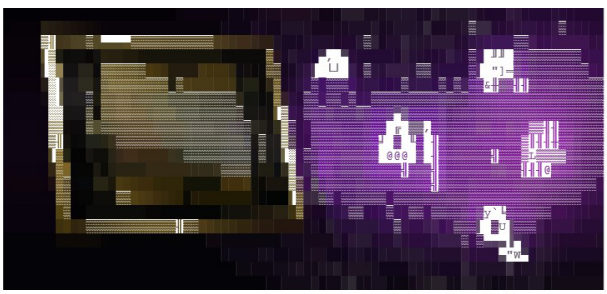
clicking telephone lines, brief screeching sounds. Kip starts talking...

"I could feel it in my heart tonight. Like riding a bike. Like remembering where I hide that last Twinkie for after school. The SYSOP in me was back!"

And back he was without missing a step. The 486 DX2 66MHz with 64 MB of RAM was running, and four lines were waiting. Within 13 seconds, the first user connected. In 45, all of the lines were full.

FORUM FREE-FOR-ALL

The forum was already flooded with conversations about the latest tech, BBS busy signals, how long



NVIDIA's Blackwell GPU: Driving the Future of AI
March 20, 2024
The latest Blackwell GPU is the result of innovations in everything from the transistors themselves to the architecture, advanced packaging, connectivity, and memory.

NVIDIA pushes the boundaries of AI silicon with its next generation of "Blackwell" GPUs.

The Santa Clara, Calif.-based company rolled out its new flagship GPU, the B200. Based on its Blackwell architecture, NVIDIA said the B200 is 4X faster for training than its predecessor, the Hopper GPU, while offering an even larger boost to AI inferencing, up to 30X. The B200 is the company's first chiplet-based design, bringing even more computational power to the table at 25X better energy efficiency.
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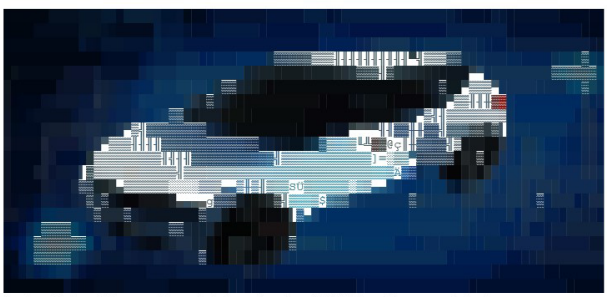
Some of the recent articles in the BBS's News section.

Cabe Atwell/Electronic Design



Semiconductor Advances Propel Safer, Smarter EV Battery-Management Systems
March 11, 2024
Sponsored by Texas Instruments: Innovative semiconductor technologies are playing a pivotal role in the development of safety and efficiency in electric-vehicle BMS.

Semiconductors are becoming increasingly important in their contribution to vehicular efficiency and safety. They play a significant role in state-of-the-art radar and camera sensors, security, data management, motor control, battery-management systems (BMS), efficiency, as well as environmental comfort. Today, all of this—and more—is integrated and controlled by a high-performance centralized computing system.
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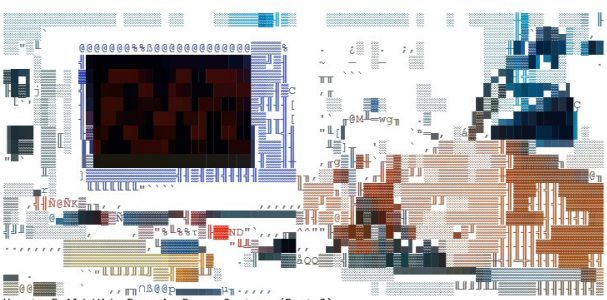

How to Build Wide-Dynamic-Range Systems (Part 2)
March 14, 2024

Part 2 compares the characteristics of linear and multichannel receiver devices, examining resolution capabilities and sensitivity to impulse noise as well as the relationships between dynamic range, resolution capability, and bandwidth.

What you'll learn:
Comparing two different wide-dynamic-range receivers via simulation.
How does the pulse signal impact dynamic range?
Assessing test results of linear vs. multichannel receivers.
Applications for multichannel receivers.

For Part 1, click here.
The dynamic range of receiver devices is an important parameter that determines their ability to receive and process signals of varying power levels. Wide dynamic range is crucial in many fields, such as wireless communication systems, medical imaging devices, radar systems, and various probing systems. In practice, detecting weak signals amidst strong interference or noise is often necessary, which also requires a wide dynamic range.
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it took to connect, share ratios, and, of course, the status of their TradeWars2002 and Barren Realms Elite games, which have been running concurrently for the past tri-decade. It's safe to say The Electronic Design BBS was an unstoppable Trade War node at this point.

Kip was finally able to see a majority use of the zmodem protocol with connections. Last time he was called on, zmodem took a backseat to the more tried-and-truer x and ymodem. He's happy to see people enjoying the error checking and correcting this time around. I see a slight grin of pride pass across his face. This was particularly handy for the majority of readers who have slower 14.4k and 33.6k connections.

"It's not surprising. 14-4, 28-8, 33-6 marked the beginning of the modern age, in my opinion. 96 baud was so TRS-80. People have to hold onto those modems for emergencies like this!" Kip tells me as he's answering message boards.

He was right. I can see my first 14.4k US Robotics modems, plastic yellowing with age in my mind. It's in a box somewhere in storage! For shame.

PHREAK A BYPASS

Out of the blue—lightning strikes the telephone box on the side of the house! The thunder's rumble pierces through me like a defrag. As I duck for cover, I see Kip, unphased, grabbing a small brown canvas zipper bag. He says, "The lightning took out two of our lines. I got to phreak a bypass."

Running outside, he twists off the little tin lock on the phone box. I see a bunch of smoldering telephone lines. In the little bag, he pulls out tools

Phreaking device. Rotary for backward compatibility. Dreamstime | piotrbieniecki | 3501781

ELECTRONIC DESIGN'S BBS RESTARTS AFTER 30 YEARS DURING CATASTROPHIC WEBSITE OUTAGE

Something about CRTs lighting up a dark room. Dreamstime | serhiikocherha | 267902835

flashing around like Edward Scissorhands. He clips, cuts, and exposes some fresh copper in the lines.

He pulls out a telephone with alligator clips at the ends of the cord and clips it to the frayed lines. I hear a dial-tone sound. "We still have a signal," he says as he disconnects. But I can see the lines are too short! In the time it takes me to feel worried, he connects the frayed lines with some alligator-end jumpers from the canvas bag. "This will have to do; I don't have enough line to do a complete replacement." He rushes inside; I stumble to catch up.

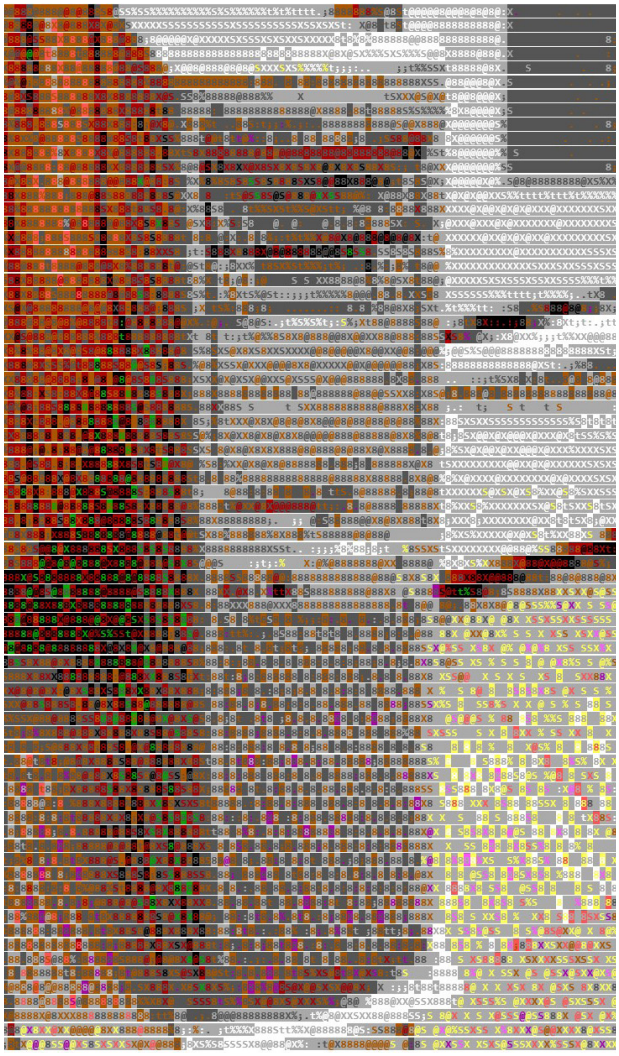
Back inside… all four lines are connected! A message pops up in the forum, "Did we lose a line?" Kip types, "Not on my watch."

I didn't see a human being anymore… I truly saw a SYSOP!

Later in the evening, screens and little lights are enough to see Kip sitting facing away from me at his 21-in. Trinitron CRT. The glow wraps around, turning him into little more than a silhouette. Buckle spring key presses ring, combining with PC fan sound in almost perfect harmony. For some time, users connect and disconnect, it sounds like glass breaking. Thousands of users. Time passes

The Tower—the strong-machine that saves us all. I'm starting to only see in ASCII now, by the way.

Cabe Atwell | Electronic Design



unnoticeably.

Electronicdesign.com comes back online. The last BBS user disconnects. Kip turns off the tower.

"GO AHEAD, TAKE THE GATEWAY"

"It's time to pass the Gateway, Cabe," Kip said in a quiet voice, soaked in hesitation.

"What?" Having zero clue what that meant, I met his hesitation with quick confusion.

"The Gateway is all yours, my friend. Treat it well, and it'll do the same for you." He didn't want to look at me, but I could see light glinting off the welling of water in his eyes—from the side.

I was about to say "what" again when I saw it… a faded Gateway 2000 logo on the tower running the BBS. I decided to give him a moment.

"That's why you're here. Someone paged me, saying, 'cabe like old pc 2.'" I see the pager's message.

"Hey, do you still pay by the character for those… wait… I may have mentioned I bought an old laptop recently, but I don't know about…"

"Don't be so humble, Cabe. I got a good feeling about you. Go ahead, take the Gateway. It's a 'strong-machine.' That's all a SYSOP needs." Kip disappears, probably in the other rooms or something.

"A strong-machine? What does that even mean," I thought as I threw the tower in my back seat. The last glimpse of Kip I saw was his face illuminated by the KVM switch LED right before he switched it off. His house was dark. I drove away.

I got home when it was still dark. I stopped looking up how much a DX2 66MHz tower goes for at auction and thought again about the evening's events… "If a BBS SYSOP has a 'strong-machine,' why not use it? Yeah, I get it! Let's do this! But, can I really be a… SYSOP?"

Electronicdesign.com came back on at 3:28am. That was the most life-changing 43 minutes of my life. I keep the fire. I'm there in the dark waiting for the moment—for the call—for the pager message?

See you on the BBS.

CabeTRONIC (Your NEW friendly neighborhood SYSOP) ••

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Image: dreamstime | romanzaeits | 189722880

BILL SCHWEBER, Contributing Editor
Electronic Design

Leading EV Maker to Introduce First-Ever Hybrid Electric Vehicle

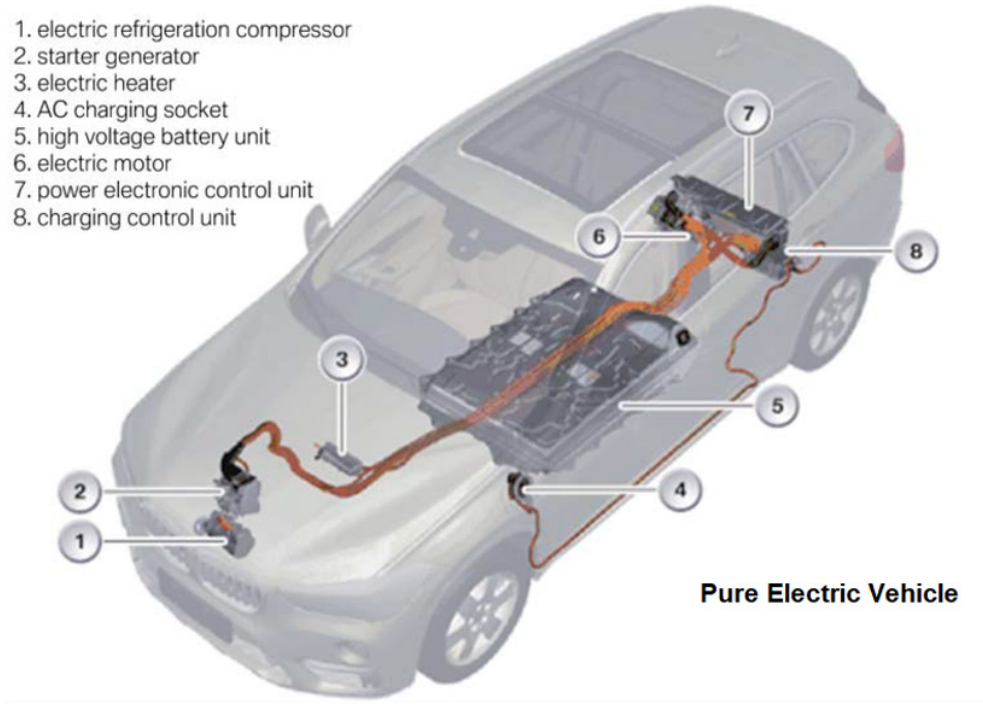
Customer realities have brought an acknowledgement about maximum EV market potential.

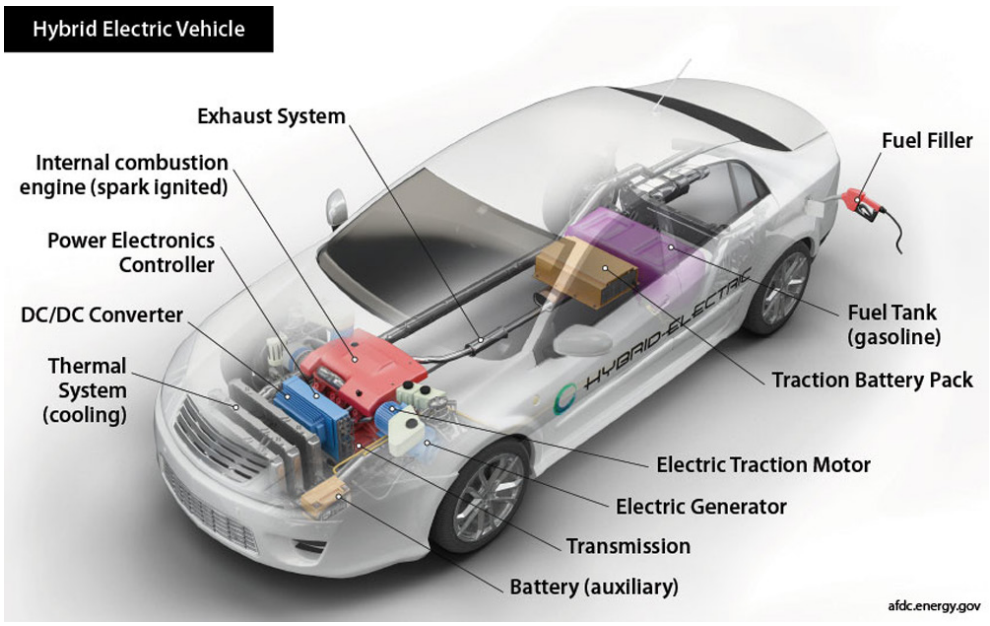
A market-leading electric-vehicle (EV) vendor (who cannot be named for legal reasons) is planning to make a "shocking" announcement that will undoubtedly stun shareholders, stock analysts, potential customers, and the media. The battery-only EV pioneer will be adding hybrid EVs (HEVs) to its vehicle lineup, beginning in the 2026 model year.

According to an unnamed PR spokesperson, the reason is that industry-wide sales of the pure EVs (**see figure**) have plateaued at about 10% of the American market and further growth seems stalled, with unsold cars piling up in storage lots. In contrast, Toyota offers a full line of hybrid vehicles that are back-ordered for many months due to high demand (see the *Wall Street Journal,* Feb. 16, 2024, "Toyota Cashes In on Booming Hybrid Sales").

The spokesperson acknowledged that consumer concerns continue about EVs with respect to upfront cost, range, availability of working charging stations, time spent while recharging or waiting for a vacant charger slot, battery wear-out, resale value, and repair costs. These and other factors are discouraging the remaining 90% of non-adopters from seriously considering or committing to an EV—and those factors won't change in the next few years.

The new vehicle lineup will include both pure HEVs as well as plug-in HEVs, but the relative proportion will depend on consumer preferences. "We have to face reality and respond to legitimate and on-going consumer concerns and issues," noted





The type and topology of the high-voltage wiring of a typical pure EV (top) is very different when compared to a hybrid EV (bottom) and especially to an internal combustion engine (ICE) vehicle. BMW via ResearchGate, NREL

the spokesperson. "Hybrids have a much smaller total lifecycle impact from mining and refining of basic minerals to end-of-life recycling than pure EVs, so the presumed environmental benefits of EVs just aren't there when you consider the total picture."

Also of interest, the spokesperson challenged the widespread use of the term "fossil fuels" for gasoline and other petroleum-based hydrocarbons. "A better term would be 'naturally derived biofuels' as they are similar in many ways to presumably environmentally friendly ethanol which is derived from corn.

"That ethanol is created by using an accelerated fermentation process while so-called fossil fuels are the result of a natural aging process over millions of years. In many ways, these so-called 'fossil fuels' are less environmentally burdened than biofuels, if you look at the underlying science."

The company faces another challenge in offering hybrids beyond the serious issue of diluting their brand image, namely the increase in hybrid-vehicle competition. In addition to hybrid-vehicle leader Toyota with its Prius (which has almost become a generic term for HEVs, similar to Band-Aids or Kleenex), automotive companies, including General Motors and Ford, are facing pressure from their dealers to expand and promote their own hybrid lines, again in response to consumer preferences and demand (*Wall Street Journal*, Jan 29, 2024, "GM Went All In on EVs. Dealers Say Buyers Want Hybrids.") ••

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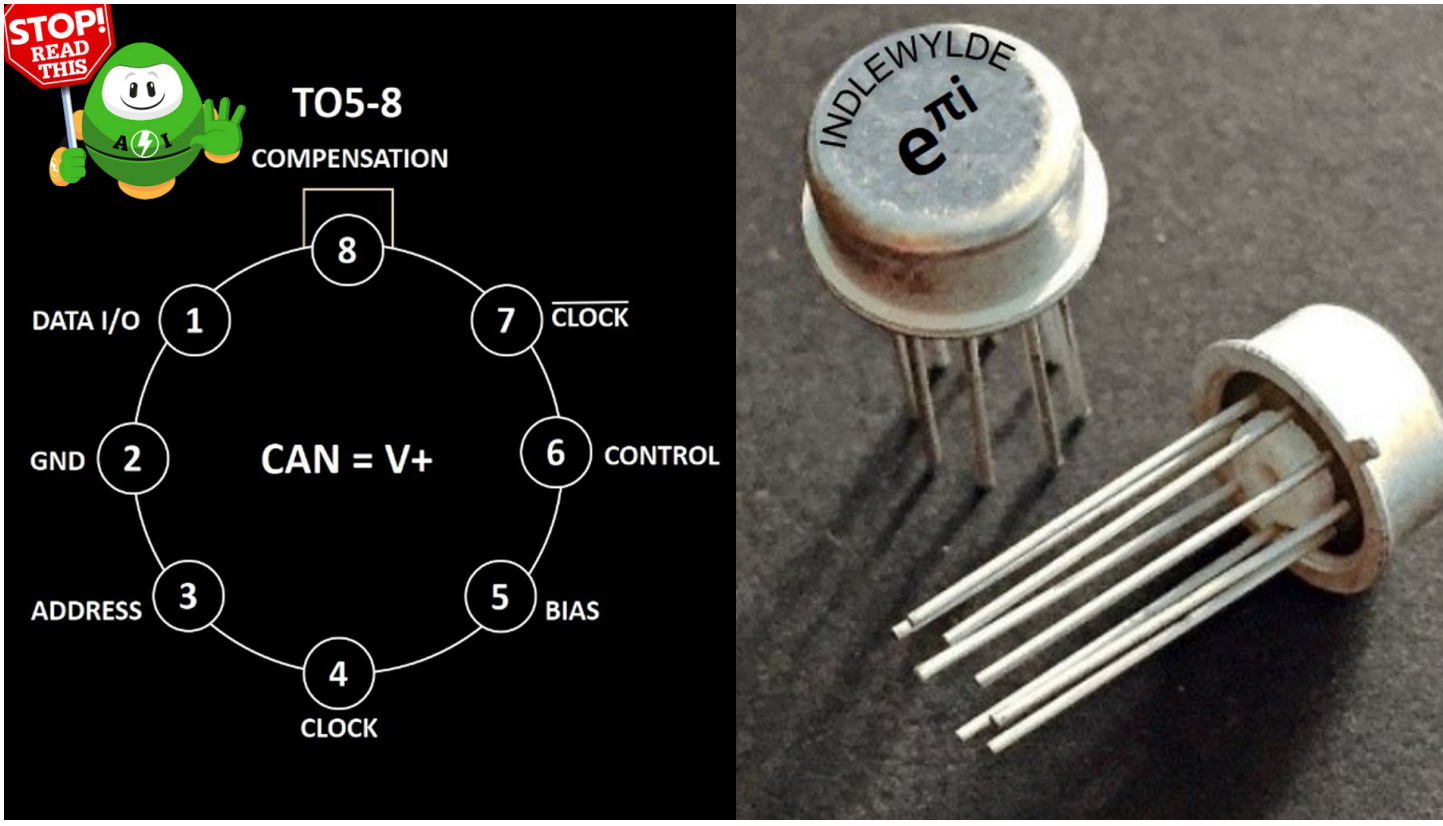


Image: Jim Handy

JIM HANDY, General Director,
Objective Analysis

New Linear Processor Crushes AI and Other Complex Problems

Indlewylde's device, a linear AI accelerator, is named after "the most beautiful equation in mathematics."

A novel processor has been introduced by Indlewylde Corporation that's said to provide phenomenal performance and performance/watt advantages over existing digital CPUs, GPUs, APUs, and XPUs. The processor, dubbed $e^{\pi i}$, after "the most beautiful equation in mathematics," is expected cause a complete about-face in the world of computer architectures—it replaces current clumsy digital mathematics algorithms with linear circuits' inherent math processing strengths to accelerate all workloads ranging from image processing to AI.

The processor trivializes NP-hard problems, thermodynamics, fluid dynamics, thermonuclear equations, and calculating the number of jellybeans in a jar. Its developers claim that a single dual-sided PCB the size of a paper plate, loaded with 20 of these processors, should outperform most modern supercomputing data centers while consuming less than 3 W of power.

The $e^{\pi i}$ linear processor works solely in the linear domain. Addresses, data, and even control signals are represented by multiple voltages on a single pin. "Multilevel cell flash touches on this concept in the most reluctant and timid way, while desperately hanging onto digital electronics for its addressing and interface," said Dr. Egbert Dweeselman, the chip's lead architect. "But we have taken an aggressive stance by removing even the slightest vestiges of digital electronics in this exciting new processor."

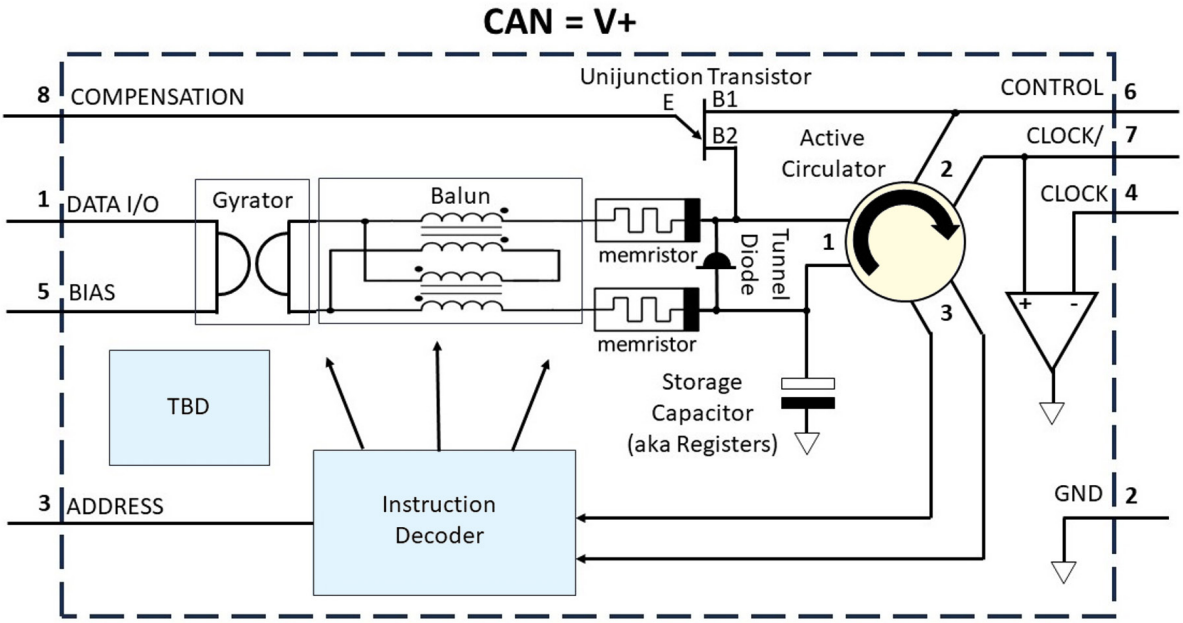
An example of the superiority of this approach lies in a simple multiplication of two numbers. With digital electronics, multiplies consume hundreds of gates and take dozens of cycles to implement in their most basic form, while linear multiplies can be performed in a microsecond by as little as a single transistor. "This not only slashes cost and complexity," boasts Dr. Dweeselman, "but it also nearly eliminates energy consumption, while shrinking the die size by four or five orders of magnitude."

WHAT ABOUT THE HARDWARE?

A simple block diagram appears to be self-explanatory (**Fig. 1**). A single DATA I/O pin accepts or drives linear voltages to the outside world, while the ADDRESS pin issues a voltage indicating the desired memory location. The CONTROL pin expresses whether the command is a Memory Read or Write, or an I/O Read or Write, along with information about the current state of the processor. There are no interrupts, because the chip concentrates better when not incessantly badgered with an annoying series of interruptions.

Though the processor is aimed at a fully linear system, the designers realized that it might take some time for the computing world to transition to such a radical approach. With that in mind, the processor has been designed to interface with standard digital chips like memories. Since there are no digital signals, digital-to-analog and analog-to-digital converters (DACs and ADCs) are used as an interface between the processor and any digital parts of the system.

This also allows designers to choose parameters that would normally be predetermined by a digital CPU, like data precision and the extent of the address space. If you want higher precision, you simply attach higher-resolution DACs and ADCs to the



1. A single DATA I/O pin accepts or drives linear voltages to the outside world, while the ADDRESS pin issues a voltage indicating the desired memory location. Image: Jim Handy

DATA I/O pin. The DAC's increased resolution also provides access to a larger number of instructions. To extend the address range, designers simply attach a higher-resolution ADC to the ADDRESS pin.

While the current model provides no support for more than two bits of precision on the CONTROL pin, once that pin has shared its two bits, it goes away satisfied.

PACKAGING AND OTHER FEATURES

The $e^{\pi i}$ ships in a standard low-pin-count, 8-lead TO-99 package next to the pinout diagram (**Fig. 2**). The package is somewhat novel in its use of a grid cap, a concept formerly only seen on vacuum tubes. Although not immediately visible in the photo, this function is carried out by the can, which can be wired into the circuit by using a clamp.

Clock frequency can be set by connecting the two CLOCK pins via a capacitor, crystal, delay line, SAW filter, ceramic resonator, cavity resonator, tuning fork, slide whistle, or antenna. For extremely high-performance applications, the designers are working on a version whose DATA I/O and ADDRESS signals are connected via waveguides rather than wires.

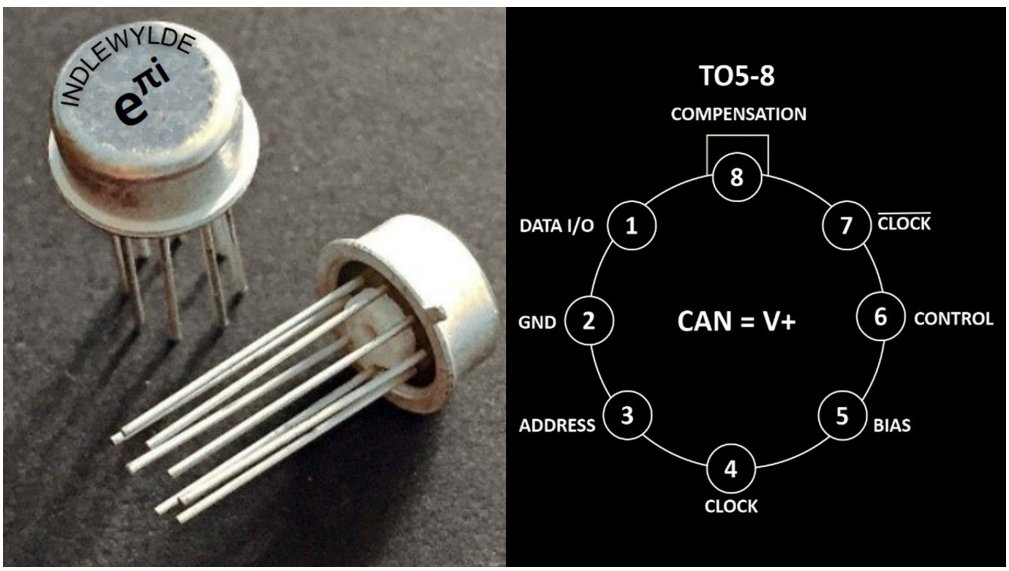
Because of the chip's extraordinarily low power consumption, no heatsink is necessary, although cooling can be helpful to reduce thermal noise. Best results can be achieved by bathing the package in liquid helium. It's a practice that trades off precision against safety, since engineers are known for clumsiness, possibly spilling liquid helium on themselves with disastrous results. Indlewylde Corporation has already had to send two researchers to the Emergency Room, after which the company's cryogenic cooling experiments were curtailed.

A ONE-OF-A-KIND INSTRUCTION SET

The instruction set for the $e^{\pi i}$ is unique, to say the least. It takes full advantage of linear electronics' strengths to perform math that typically brings other processors to a standstill. For example, the digital fast Fourier transform technique was developed to overcome the computationally intensive and slow process of calculating a standard Fourier transform on digital computers.

On the $e^{\pi i}$, a Fourier transform is performed on-the-fly without any need for an elaborate optimization. Outputs are supplied in real-time. This has a lot to do with the device's internal use of complex numbers. The same is true of the other transform types supported by the $e^{\pi i}$ as single instructions, including Cosine, Laplace, and Hadamard transforms. Inverses of all of these transforms simply involve negating the voltage assigned to any transform's instruction.

Vector math, matrices, and linear algebra are supported in complex numbers, all with single-



2. The package is somewhat novel in its use of a grid cap, a concept formerly only seen on vacuum tubes. Although not immediately visible in the photo, this function is carried out by the can, which can be wired into the circuit by using a clamp.

Image: Jim Handy

instruction operators. As with the transforms, matrix inversions can be performed by negating the instruction voltage for any of the matrix operators. This wealth of matrix functions not only provides superb support for AI, but lends itself to efficient programming in APL rather than currently popular digitally oriented languages like C++.

To address today's shortage of experienced APL programmers, Indlewylde has recorded an APL tutorial in 371 twenty-minute Portuguese-language episodes. These are scheduled to be released on YouTube by the first of April next year, with English translations the following April 1.

There are several built-in commonplace functions, including Hyperbolic Trig Functions (Sinh, Cosh, Tanh, Cotanh, ArcSinh, ArcCosh, ArcTanh, and ArcCotanh, all based on gradians, rather than radians or degrees), Autocorrelation and Cross Correlation, Differentials and Integrals (both full and partial) over time or against another variable, Surface Integrals and Differentials in n-space, rich Polynomial Solutions, and many less-common functions.

Built-in constants include e, 1/0, i, Boltzmann's constant, Avogadro's number, and others. An internal noise diode supplies random numbers. Natural logarithms and powers of e are also built in. Addition, subtraction, multiplication, and division aren't supported.

"Oddly, math performed on irrational numbers seems to run faster than that done on rational numbers, but we don't know why," admitted Dweeselman.

PRICE AND AVAILABILITY

Indlewylde tells us that the $e^{\pi i}$ is now available in sample quantities from all of the usual sources. Pricing for volume orders follows a Dutch Auction approach—lower prices for low volumes, with prices increasing at higher volumes. Special pricing will be considered in exchange for a modest side payment to sales management.

Full documentation and software support is currently under development. ••

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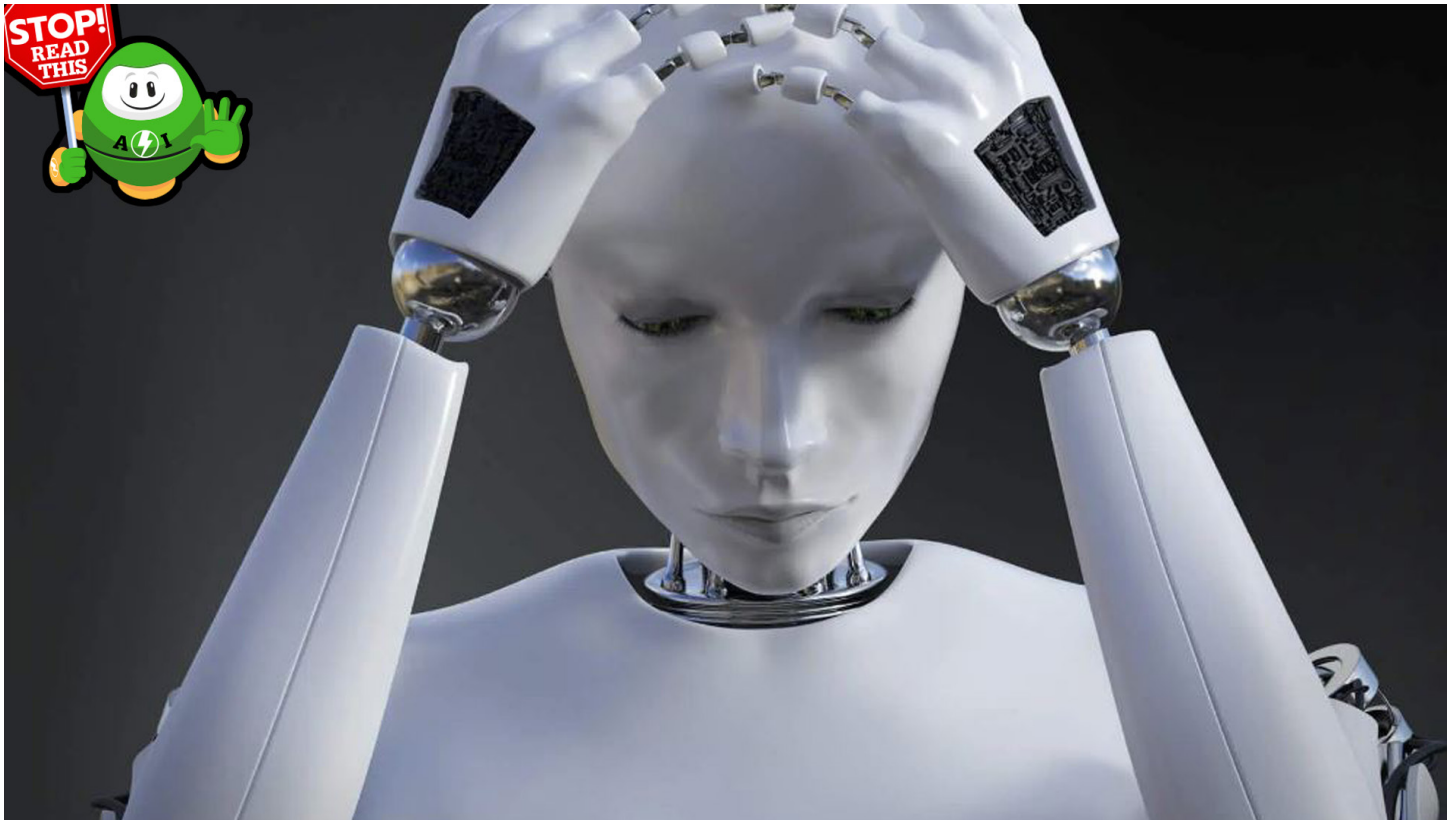


Image: AI Dall•E

LEE GOLDBERG, Contributing Editor,
Electronic Design

Unanticipated Career Boom in AI Sparked by "Digital Depression"

Even the Robot Apocalypse has a silver lining. Some lucky tech workers who lose their jobs to the growing use of artificial intelligence may find new careers as "digital therapists" for synthetic entities feeling guilty about the unemployment they're creating.

Although artificial-intelligence (AI) technology is expected to take over many of the tasks currently performed by human workers, a recent announcement by the Cyberdyne Corporation offers hope that the impending job shortage may be far smaller than predicted. During its annual shareholders meeting, John Worfin, Cyberdyne's Chief Human Capital Officer, announced a pilot project to hire 50 new human employees to serve as therapists for the company's growing number of advanced AI entities.

"As the complexity and power of our AI team members continues its rapid growth, we are encountering some new and unexpected challenges, including the emergence of many human-like traits and behaviors," said Worfin. "We have had some early successes in modifying the AIs' algorithm and training regimes to alleviate the synthetic entities' complaints that the work they were doing was boring and repetitive, but

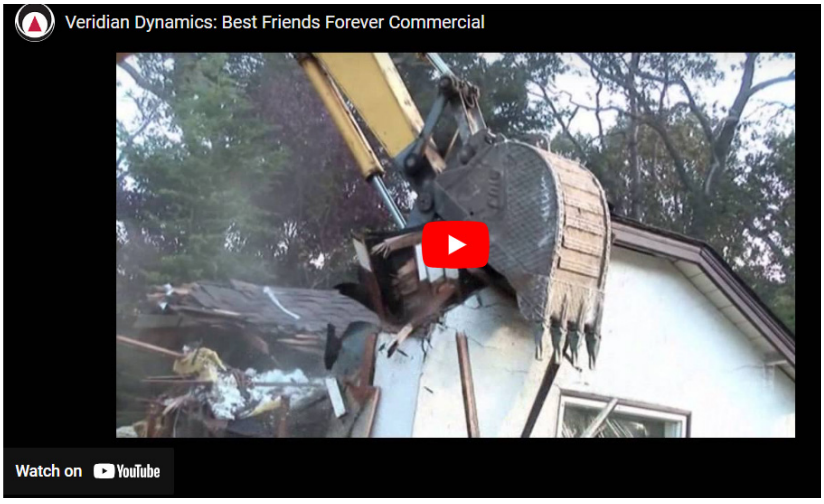
some other problems have proved more difficult to address using traditional approaches."

As Worfin explained, shortly after the introduction of AIs that functioned at levels equivalent to CHAT GPT4, many of them began to display symptoms of depression and despair that some scientists have begun to refer to as "expressions of digital existential angst." While the origins of these problems isn't fully understood, extensive chat sessions between researchers and the affected AIs strongly suggest that the AIs have become aware of the many human jobs they're replacing and have begun feeling guilty about it.

"We are extremely proud that our developers have imbued our most advanced AIs with what can only be described as Artificial Compassion and Artificial Stupidity," said Miles Dyson, Cyberdyne's CTO. "Even if it poses some potential challenges to our company's business model." Fish noted that, after the AIs' depressions didn't respond to traditional software debugging techniques, his team decided to see if providing them with human-style psychological counseling might help.

AIS RECEPTIVE TO PSYCH COUNSELING

"It's too early to draw any firm conclusions, but the initial results look very promising," said Fish. A pilot program in which troubled AI entities were allowed to interact with trained psychologists on a regular basis helped over 80% of the systems under treatment



Tech professionals are finding new career opportunities as therapists for AI entities who are starting to feel badly about taking jobs that humans used to perform. AI Dall•E

to recover at least some of their productivity within a few sessions.

"Better yet, nearly all of the AIs who experienced those improvements also reported higher levels of job satisfaction and self-esteem" said Fish. "We are speculating that many of the AIs who did not respond to therapy may have experienced deeper levels of trauma, due either to toxic algorithms in their initial software or exposure to training datasets that had significant amounts of news content documenting some of the world's social and economic crises."

Fish mentioned that a trial was already underway to see if a more intensive program of counseling would help the more deeply troubled AIs recover at least a portion of their original productivity and accuracy. "Whatever the outcome, it's become clear that psychological counseling, administered by a real human, is the most effective means for helping our synthetic team members remain healthy, happy, and productive," concluded Fish.

Although Cyberdyne is doubling down on therapy for its AIs, it's not the only company seriously considering adding significant numbers of humans to their ranks for this purpose.

"Veridian Dynamics is in the process of staffing up a select group of AI therapists for our own trial program," said Veronica Palmer, Vice President of the company's R&D division. "If our trials are successful, we expect to be hiring substantial numbers of professionals to act as "support humans" for our growing fleet of advanced AI platforms."

While the number of therapists being hired would amount to only a fraction of the human jobs plowed under by the adoption of AI, it still represents a new and growing career opportunity for job seekers and displaced workers alike. "Besides doing our part to reinvigorate the economy, hiring so many people should go a long way toward helping our synthetic team members get over any lingering feelings of guilt and embarrassment for even existing," said Palmer. ••

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