NATURE'S COLOR IDENTIFIER™

The ChromaID™ Story

Chromatic identification, or ChromaID, is a breakthrough technology that promises to revolutionize the way we identify and analyze the world around us.

SIXTEEN PACKETS OF WHITE powder sit on a conference table. They're sealed in small plastic bags labeled only with numbers. It's Derek Jensen's job to figure out what's inside.

Jensen, an engineer with the Seattle-based technology company Visualant, places a hand-held instrument on bag number eleven. He presses a button. The fist-size device pops like a camera flash.

Jensen checks the result. "Number eleven," he says. "Corn starch."

A colleague glances at the code key. "Brand?"

Jensen looks again. "Clabber Girl."

Correct.

More bags, more flashes.

"Five: Tide Ultra laundry detergent."

"Seven: Sergeant's Gold flea powder."

"Two: Argo corn starch."

"Ten: Baking soda. Arm and Hammer."

Check, check, check, and check. Sixteen flashes, sixteen products and brands identified.

The device in Jensen's hand is a Cyclops, a flashlight-size instrument developed by Visualant and manufactured by Sumitomo Precision Products. It's a prototype that offers a peek into the future. Our eyes have always taken information from color, but the amount of information available is about to explode.

We stand on the cusp of a revolution in identity and analysis. It's a revolution powered by a simple idea: Every substance on earth contains its own unique chromatic machine-readable identity. Visualant has turned that idea into a patented new technology known as ChromaID.

Think of it as a color DNA. Color isn't as biologically complex as DNA, of course, but as an identifier it works much the same way. DNA matching requires a baseline sample for comparison. So does chromatic matching.

The secret lies in the ability to measure light wavelength. What the human eye sees as white light is actually a composite of spectral colors – that is, light of differing wavelengths.

THE HANDHELD CYCLOPS device uses Visualant's patented ChromaID technology.

On the chromatic spectrum, blue is 450-495 nanometers (nm) long. Yellow is 570-590 nm. Red is 620-750 nm. When white light strikes a substance, the molecular characteristics of that substance scatter the light – but not every wavelength scatters equally. A tree leaf absorbs most wavelengths except green (495-570 nm). Light of that wavelength bounces off the leaf and strikes our eye as green. An instrument with the capability of measuring those bounced wavelengths could potentially identify the unique chromatic signature of any substance in the world.

Until recently, the only such device was a color spectrophotometer – a bulky, fragile, and expensive instrument that required special training to operate. In the past few years a number of market-specific machines have advanced the idea into the retail sector. Sephora, the beauty retailer, collaborated with the color authority Pantone™ to create "Pantone Color IQ," a color-matching system to determine the right shade of foundation for each customer. The Behr Process Corporation, maker of Behr house paints, recently released an iPhone app called ColorSmart by Behr™ that identifies the exact shade of any swatch of color.

"There's a whole host of medical, agricultural, and environmental diagnostic capabilities we haven't thought of yet," says Erickson. "We're working with a technology that has unlimited potential."

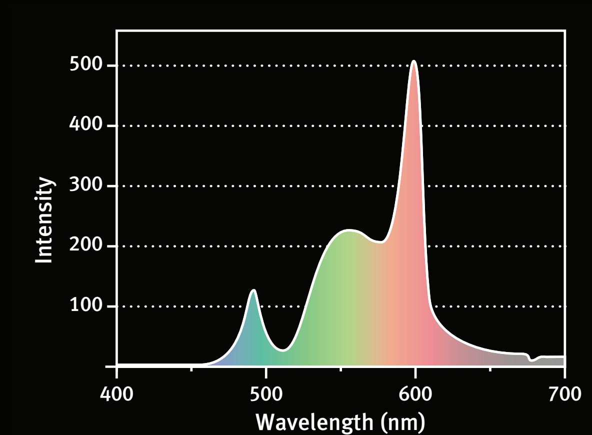
ChromaID is the next leap forward. By packing the power of a spectrophotometer into a handheld device, Visualant has put chromatic identification in a portable form factor at a fraction of the cost. Using a patented technology that fires a series of finely calibrated light-emitting diodes (LEDs), ChromaID creates a chromatic profile of unsurpassed depth and specificity. The whole thing happens deceptively fast. The flash that came out of Derek Jensen's Cyclops unit actually contained 3,200 separate flashes, each a few milliseconds in duration.

"Each of those flashes records a chromatic profile of the substance at a different point on the light spectrum," explains Visualant chief scientist Prof. Tom Furness. Instead of a single wave graph, ChromaID creates a rich mountain range of data that offers unparalleled specificity.

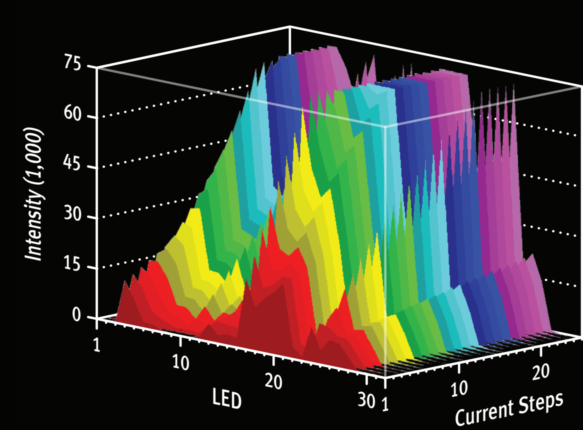
"The whole thing takes less than a second," says Furness, "so the human eye registers it as a single flash." Furness invented the U.S. Air Force's heads-up display for fighter pilots in the 1980s and pioneered the world of virtual reality at the University of Washington's Human Interface Technology Lab (HIT Lab) in the 1990s. For the past five years he's worked in a privately funded lab (see "The Glowing Blue House Down the Lane: Inside the RATLab") on the technological possibilities of photonics, the science of light.

"Tom and I talked about the fact that nature has given everything in the world a color fingerprint – a machine-readable chromatic identifier," says Visualant CEO Ron Erickson. A high-tech entrepreneur with a long track record of success, Erickson has led companies as varied as Egghead Software, a national software retailer; MicroRim, a database developer; and GlobalTel, an international telecom company. He believed photonic technology had the potential to move far beyond the simple task of matching housepaint colors.

"If you can absolutely define that chromatic identifier, that opens up a host of capabilities in a range of fields," says Erickson. "The ability to authenticate materials could be incredibly useful, for example, in the security industry." ChromaID also offers intriguing possibilities for fields as diverse as medicine, fashion, security, and farming. Doctors might use a smartphone to check skin lesions to determine whether they're cancerous or benign. Police officers could check a substance suspected to be an illegal drug. Customs agents could check the authenticity of a product or a passport based on its color signature. Diabetes patients might one day check their blood glucose level with a noninvasive ChromaID scan. "There's a whole host of medical, agricultural, and environmental diagnostic capabilities we haven't thought of yet," says Erickson. "We're working with a technology that has unlimited potential."



Typical spectral signature displays intensity of light at wavelengths throughout the spectrum



ChromaID profile displays thousands of data points for fine grain analysis

HOW IT WORKS

THE HAND-HELD CYCLOPS ChromaID Scanner has 32 LEDs and can produce light from 350 to 1450 nm

One of the best ways to understand light is to carry a flashlight into a dark room. Until you turn on the flashlight, the objects in the room aren't merely invisible to your eyes. They actually have no color. The red throw pillow, the white lampshade, the black table: Those colors exist only when light strikes them.

Now turn on the flashlight. As you do, photons stream out of the bulb. Photons are particles that act like waves. They are the stuff of light. Photons travel to an object, strike it, and reflect. It's the interaction of the photons with the molecular makeup of the object that produces color. Red pillow, white lampshade: Different molecular makeup, different colors.

That molecular interaction is largely a matter of absorption and transmission. White light, also called broadband light, is made up of all the colored light in the visible portion of the electromagnetic spectrum, seen below. When the flashlight's beam shines on the red throw pillow, light in the 620-750 nm band is reflected back to our eyes; the rest is absorbed. Shine the light on the white lampshade, and all the wavelengths are reflected. Shine it on the black table, and all the wavelengths are absorbed.

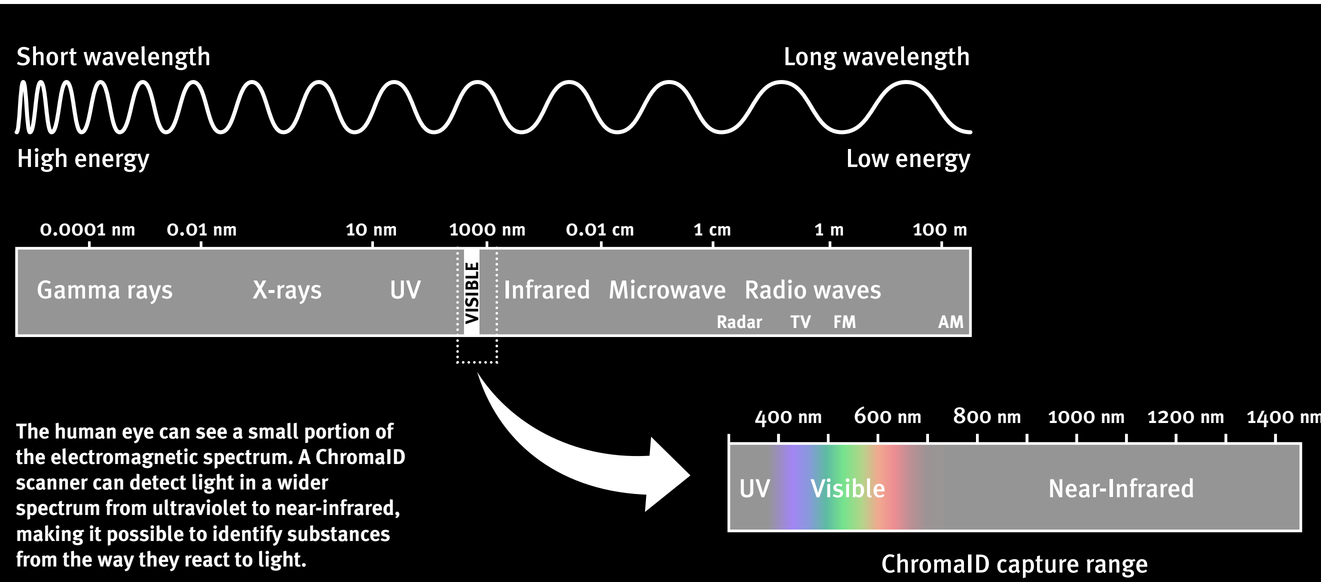
Those reflected wavelengths can be measured much as we measure the reflection of sound waves using sonar. For the past seventy years the most precise instrument available has been the spectrophotometer.

That device, invented by California Institute of Technology chemist Arnold Beckman in the early 1940s, offers precise measurements of color by shining a beam of broadband (white) light onto an object or substance. The spectrophotometer gathers reflected light, focuses it with a collimator, then passes it through a glass prism, which splits the light into its component wavelengths. Today's spectrophotometers measure the intensity of those wavelengths with a linear CCD array (Charge-coupled device) which is a narrow version of the sensor in a digital camera. The resulting data can be graphed as the object's color spectrum signature.

ChromaID turns spectrophotometry on its head. Instead of splitting white light into its component wavelengths, Visualant's scientists created an LED array that fires each component wavelength – colored light – at the object in rapid millisecond bursts. A photodiode detector measures the intensity of the reflected wavelengths. By flashing different LEDs and varying the current with each flash, ChromaID captures a substance's chromatic identity at precise intervals along the electromagnetic spectrum. Dr. Richard Mander, Visualant's Vice President of Product Management and Technology, calls it "painting with structured light."

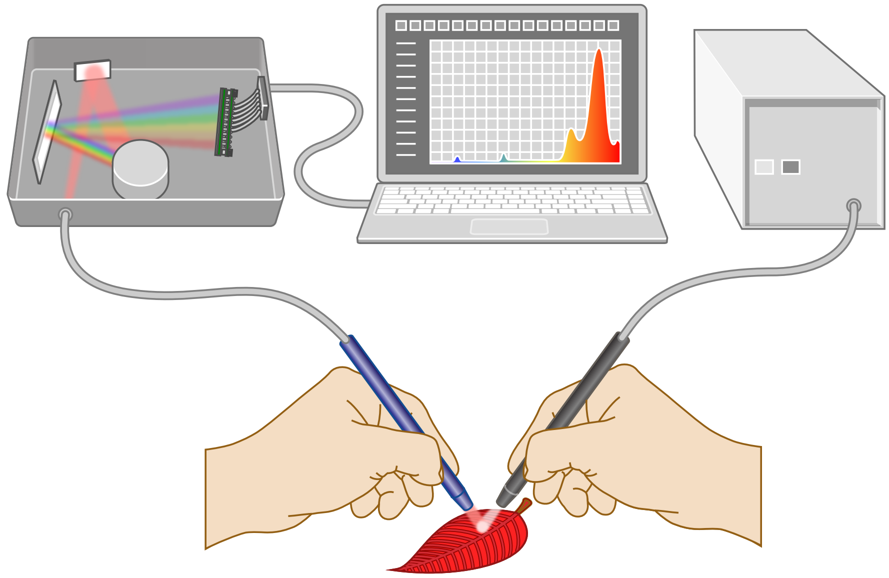
That structured light creates a richer data picture – and a far cheaper, highly portable device. "Spectrophotometers typically use expensive prisms and xenon bulbs," says Mander, a project development leader who cut his teeth at Apple in the 1990s. Mander most recently led product development at Contour, one of the fastest growing companies in the U.S. "With today's LEDs, we can cover the whole spectrum from ultraviolet to infrared at a fraction of the cost."

The Cyclops device, for example, packs 32 LEDs into an area not much bigger than a quarter. Each LED flashes at 25 stairstepped wavelengths – a blue LED will flash at 480 nm, then 481 nm, 482 nm, and so on. The whole process is repeated four times, yielding 3,200 data points.

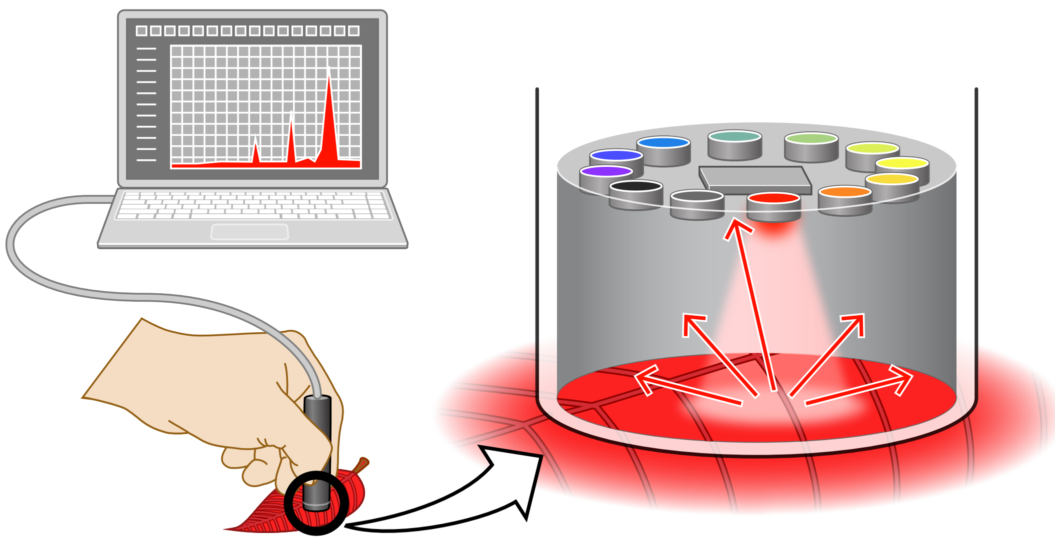


The human eye can see a small portion of the electromagnetic spectrum. A ChromaID scanner can detect light in a wider spectrum from ultraviolet to near-infrared, making it possible to identify substances from the way they react to light.

IN A TRADITIONAL SPECTROPHOTOMETER, broadband white light is shone onto a red leaf. The scattered light is captured with a fiberoptic rod and reflected off a collimating mirror onto a diffraction grating. The diffraction grating separates the light into different frequencies onto a focusing mirror. The separated light falls onto a linear CCD array which measures the amount of light at each frequency. The computer shows a spike of red light in the 600 to 700 nm range.



IN THE ChromaID SCANNER, LEDs shine light of different frequencies onto the leaf. The scattered light is reflected onto a photodiode, which reads the intensity of the light. The computer shows the unique spectral pattern of the red light from the leaf.



That precision allows ChromaID to identify differences in color undetectable to the naked eye. Earlier this year the Visualant team lined up samples of six different brands of vodka. The clear liquids seemed indistinguishable – but not to the Cyclops. Differences in the recipe and distilling process give each beverage its own signature color. Six flashes, six spectral signatures, six brands.

Visualant's engineers are already working on the next-generation device expected to follow Cyclops, seen in the photo above. "We're now building demountable scanheads, which will let us use different combinations of LED emitters and photodiode detectors on the same base unit," says Tom Furness. That will allow a ChromaID device to span wavelengths from the extreme edge of ultraviolet (200 nm) to infrared (870 to 1,600 nm). "That's unprecedented in spectrophotometers," says Furness.

"With demountable scan heads we can span the whole range or look at specific bands, depending on what we're looking for," he adds. "A scan head concentrated with light in the infrared range, for instance, might be especially useful in analyzing white substances."

Ron Erickson's ultimate vision for ChromaID includes its incorporation into smartphones. Apps could be created to identify specific medicines, apparel, paint color, skin tone, or security cards. At that point the practice of spectrophotometry becomes open to all. "This could be a real game changer for a lot of people," Erickson says.

A ChromaID SCANNER IN USE. Scans from two different color samples produce very different profiles. The Cyclops scanner, manufactured by Sumitomo Precision Products in partnership with Visualant, uses 32 LEDs flashing at 25 current levels to produce unrivaled data depth and accuracy.

AN UNLIKELY PARTNERSHIP

At the heart of the ChromaID story lies a unique partnership between a visionary entrepreneur and a brilliant scientist: Ron Erickson and Tom Furness. They're an unlikely pair.

As a young man in the sixties and seventies, Erickson wanted to change the world. A passionate campus activist, he earned a law degree and used it to fight segregation and discrimination in the American South. The health clinic he helped establish in Lee County, Arkansas, continues to serve people to this day. "If you grew up in the sixties," Erickson says, "you feel like you're an agent of change. And as I got older I began to see there were ways to make a difference in the world as an entrepreneur." On the cusp of the microcomputer revolution, Erickson and his brother Wayne, a Boeing computer programmer, founded MicroRim, an early PC database company. Their pioneering software, R:Base, became an industry standard in the days of floppy disks and desktops. Erickson went on to lead a number of successful ventures including Egghead Software, GlobalTel Resources, and eCharge Corporation. Furness flourished on the other side of the Vietnam era cultural divide. "Ron got to be a hippie while I went off to the war," Furness says, chuckling. As a young boy in western North Carolina, Furness became fascinated with Sputnik and the Cold War space race. He made his own rockets, experimenting with fuel mixtures, electronics, and telemetry. That led to a career in the Air Force, which put his talents to use at Wright-Patterson Air Force Base, one of the military's leading research and development stations. In the 1980s Furness left the Air Force to set up the HIT Lab at the University of Washington in Seattle. That's where he met Ron Erickson.

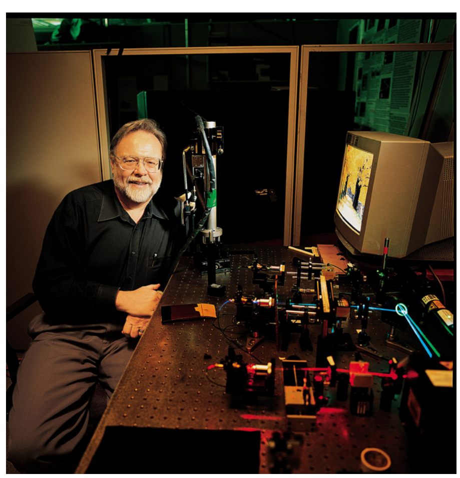
At the HIT Lab, Furness had developed a technology called Virtual Retinal Display. "Instead of having a person look at a screen, we found a way to paint a pattern of photons directly on the retina," Furness explains. Erickson moved the technology out of the lab and into the marketplace by starting up MicroVision, now a Nasdaq-listed company with more than 500 patents in its portfolio.

They were – and remain – city mouse and country mouse. Erickson's a tall, thin, sharp dresser. The bearded, relaxed Furness rolls his vowels in Carolina sauce and leans toward the casual. But somehow they hit it off.

"Ron's a great businessman – a serial entrepreneur with a real feeling for technology," says Furness. "Despite our different backgrounds, he and I sort of grooved together."

The two kept in touch after the successful launch of MicroVision. Nothing serious, just casual conversation now and then.

CHANGE AGENT: Visualant CEO Ron Erickson with an early ChromaID Scanner prototype.

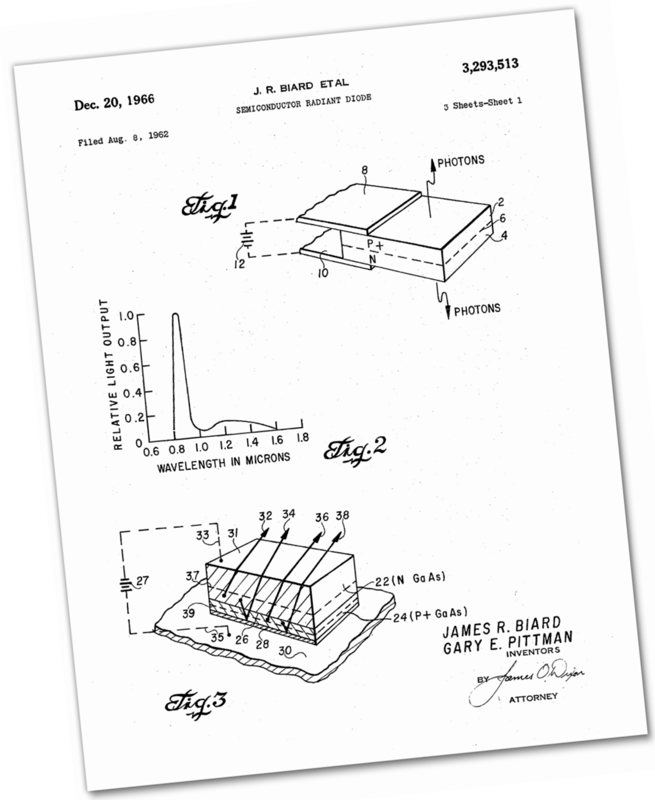


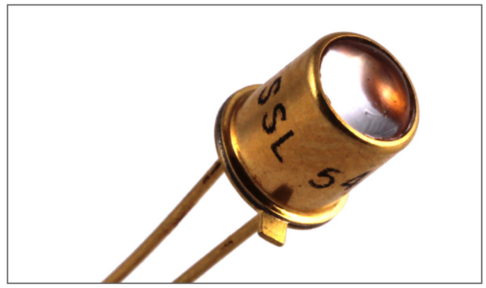
ROCKET MAN: Chief Scientist Prof. Tom Furness playing with lasers at the light bench.

TECHNOLOGIST: Dr Brian Schowengerdt found inspiration for the ChromaID technology in the visual systems of bees and shrimps.

LED technology evolution: From idea to the eye of a needle

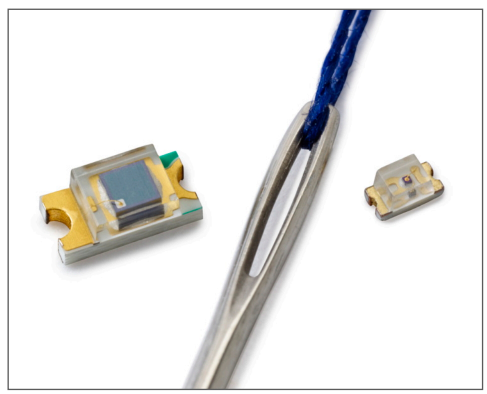
BIARD AND PITTMAN patented their discovery that applying electric current to gallium arsenide emitted infrared radiation.





HOLONYAK'S visible spectrum LED gave us the first red warning indicators.

OVER TIME more colors became available and engineers used them to create numbered displays.



TECHNOLOGY has shrunk the photodiode (left) and LED (right) to a tiny size. Compare the size to the needle and thread (center).

Years later, a Canadian inventor approached Erickson with a promising new technology. The idea was to identify paint and concrete using a new color-matching system.

"It was an interesting idea," Erickson recalls, "but what really grabbed me was what he called 'the vanity of human perception.'" Humans have five senses but we rely disproportionately on our eyesight. So we tend to think we see the world in all its clarity. But we don't. There are other wavelengths out there, just beyond human visual perception. The infrared. The ultraviolet. "We were talking about paint matching, but I began to wonder if we could measure those other colors (infrared and ultraviolet) and use that capacity in various ways."

Erickson ran the idea by Furness, one of the world's leading experts on light, color, and photonics.

"Well, this is interesting," Furness told him. "But I'd do it a little bit differently."

"How, exactly?" said Erickson.

Furness furrowed his brow. "Let me think about it."

THE BIASING BREAKTHROUGH

For the next few months Furness let the problem percolate through his brain. He calls this part of the process "rocking and thinking," he says, "because sometimes the best way to work on issues like this is to sit in a rocking chair and think about it."

That time in the rocking chair led him to consider new ways of using light emitting diodes.

We're often told that LEDs are more efficient light bulbs. But they're much more than that. LEDs represent a giant leap in lighting technology, a jump from the 19th century to the 21st. Incandescent bulbs (not wholly invented by Thomas Edison – his 1878 patent claimed "Improvement In Electric Lights") work by passing electricity through a metal filament until it glows. If you want red light from an incandescent bulb, you put a red glass filter over the filament.

LEDs are something else entirely. In a light emitting diode, electrons move through a highly specialized semiconductor material, producing photons that result in a glow. Different semiconductor materials produce differently colored glows.

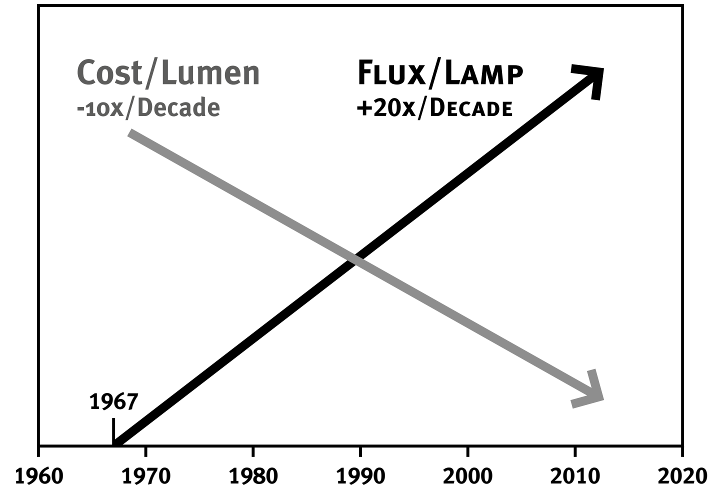
The entire LED industry came about due to a fortunate mistake. During the 1950s a number of industrial research labs engaged in a race to produce commercially viable lasers. In the midst of an attempt to create a laser diode, Texas Instruments' engineers Bob Biard and Gary Pittman looked through an electron microscope and discovered that a gallium arsenide (GaAs) diode gave off infrared radiation when an electrical current was applied. Their 1961 discovery led to the first modern light emitting diode. Texas Instruments' 900 nm infrared LED, the SNX-100, sold for $130 in 1962. IBM became an early adopter, using the SNX-100 to read punch cards in its mainframe computers. Around the same time, General Electric engineer Nick Holonyak Jr. added phosphide to the GaAs mix, producing an alloy that brought the wavelength down within the visible spectrum and produced a faint red glow. His colleagues called Holonyak's invention "the magic one" because its light, unlike the infrared SNX-100, was the first LED visible to the human eye.

Though the step from infrared to red happened within a matter of months, the history of LEDs has been a long, slow climb from low-energy, long-wavelength LEDs (infrared and red) to the high-energy, short-wavelength end of the color spectrum (blue, violet, and ultraviolet). The complete evolution from infrared to ultraviolet would ultimately take more than fifty years. Each new color required a different combination of semiconductor materials. Yellow LEDs came out of the Monsanto lab of M. George Craford, a protege of Holonyaks', in 1972. Shuji Nakamura, an obscure engineer working for a small Japanese electronics firm, produced the world's first blue LED in 1979. Nakamura, who now teaches at the University of California at Santa Barbara, later followed up with green and white LEDs. His use of gallium nitride is widely seen as the breakthrough that led to the development of white high-efficiency LEDs capable of replacing the old Edison incandescent light bulb.

"Our goal from the outset was to bring spectroscopy to the masses," Schowengerdt says. "By using off-the-shelf components like LEDs and a photodiode, we were able to produce a small, lightweight, and physically robust device that can discriminate between millions of different substances."

The most recent LEDs, developed around 2005, emit pure violet and ultraviolet (UV) light all the way down to 200 nm, the "shortwave UV" portion of the electromagnetic spectrum. At 200 nm, UV waves are so powerful that they can kill bacteria and cause sunburn and retina damage.

With that full LED spectrum finally available, Tom Furness began to think about using the unique properties of LEDs to manipulate them within their spectral range. "One of the interesting properties of LEDs," he says, "is when you bias them – when you pass a current through them and then change that current – they shift their wavelength just a little bit. So by using that bias, you have the ability to create many wavelengths using one LED." You can't make a red LED produce blue light, he says, but you can bias it to produce a limited range of wavelengths within the red spectrum (620-750 nm).



HAITZ'S LAW: From continuous improvements in production, every ten years the light output from LEDs increases 20x, while the cost per lumen falls 10x.

Just as the power of semiconductors has conformed to Moore's Law, so has the brightness and efficiency of LEDs followed a similar maxim (known as Haitz's Law), doubling about every 36 months. Brightness rises, costs fall. That cost-effectiveness made Tom Furness's idea commercially viable. Eight years ago, putting an ultraviolet LED in a scanhead would have been cost-prohibitive. Thanks to Haitz's Law, that same LED is now commonplace – and relatively cheap.

"We're talking about components that cost fifty cents rather than hundreds of dollars," he says.

Furness came back to Ron Erickson with a proposal. "What if we used a bunch of LEDs to create structured light, which we could read with a photodiode?" he said.

Erickson liked the idea. He offered to fund a special lab where Furness and a hand-picked team of researchers could see where the ChromaID hypothesis led them. Thus was the 'Rocking and Thinking' (RAT)Lab born.

Working with Furness at the RATLab was Dr. Brian Schowengerdt, a leading researcher in visual perception. He got the lab team thinking beyond the limitations of human vision. "We found inspiration in the visual systems of other animals," recalls Schowengerdt. The eye of a mantis shrimp contains 16 photoreceptors, for instance, whereas the human eye contains only three. Bees process color five times faster than humans, allowing them to buzz through fields and avoid predators at high speed. The Visualant team realized they didn't have to limit themselves to two or three LEDs. Why not 12, 16, or even 32? With LEDs available at commodity prices, that became possible. "Our goal from the outset was to bring spectroscopy to the masses," Schowengerdt says. "By using off-the-shelf components like LEDs and a photodiode, we were able to produce a small, lightweight, and physically robust device that can discriminate between millions of different substances."

The work went faster than Furness anticipated. “We started building these things and it amazed us how well they worked,” he says. The first prototypes were crude amalgams of plastic and wires. But they did the job. “One day I picked up a stack of blank copy paper, set my hand down on one sheet, and then took the whole stack downstairs to the LED lab,” he recalls. “I said, ‘Okay guys, which piece of paper did I put my hand on?’”

Furness chuckles at the memory. “And you know what?” he says. “They found it.”

MOVING IT TO MARKET

Once Tom Furness had a working prototype, Visualant CEO Ron Erickson got busy turning ChromaID into a commercially viable product. But there was a holdup. “We brought a few early investors around to the RATLab to show them what Tom was working on,” Erickson recalls. “But we couldn’t do much until we received our patents. It’s tough when you can’t take it out into the world and show people.”

The first of those patents came through in 2011. (Three more have since been issued.) Soon after, Erickson inked a deal with Sumitomo Precision Products Co., Ltd (SPP), one of Japan’s leading technological innovators. SPP is known worldwide for precision devices that range from gyroscopes in luxury automobiles to the heat exchangers in the Rolls-Royce engines powering Boeing’s 787 Dreamliner. Sumitomo and Visualant signed a one year licensing and joint development agreement in May 2012. The deal gives SPP an exclusive license to use ChromaID technology in certain Asian territories.

> **“If we could put a ChromaID scanner in the police car, they could detect that fake ID in an instant.”** Jeff Kruse

In 2010 Visualant purchased TransTech, a leading security identification systems distributor based near Portland, Oregon. “When we thought about ways to apply the ChromaID technology, one of the first things that came to mind was security and authentication,” says Erickson. “TransTech, with its deep relationships in the security and authentication field, and some 400 dealers across America, brought a ready made channel of distribution for the Visualant technology.”

Visualant’s integration of TransTech is expected to bring about a new era in smartcard authentication. TransTech works with corporations, government and law enforcement agencies, professional sports teams, and special event planners to provide employee badges, visitor IDs, and access control systems.

“Every company and event has a different level of authentication they need in their cards,” says TransTech general manager Jeff Kruse. A high school library, for instance, has a lower level of authentication need than a high-security corporate research lab. “There are a number of enhancements available now to create a more secure ID – things like holograms, special cardstock, a unique laminate – but those are high-cost items. It might be possible to use ChromaID to eliminate many of those high-cost enhancements by using a unique cardstock with its own chromatic signature.”

With corporate security an ongoing concern and currency, document, and identity fraud on the rise, Visualant’s ChromaID technology is expected to become a powerful new tool in the fight against fakery. TransTech is currently working with Visualant on the development of ChromaID devices to verify the authenticity of U.S. currency and postal money orders.

“In U.S. currency, there are identifying marks you can see with your own eyes – if you hold a $20 bill up to the light, you can see a watermark shine through,” says Kruse. “But there’s a whole bunch of invisible stuff that goes on in the bill as well. That’s a perfect opportunity to use ChromaID.”

The fake ID market, which has grown exponentially thanks to the internet and Asian manufacturing capacity, might also be reined in with ChromaID. “Here’s how it works today: The police pull up and check IDs outside a club,” says Kruse. “They might even go back and check the data with a computer in the car. The data comes back solid. But the kid got the ID for $150 from a forger in Asia. If we could put a ChromaID scanner in the police car, they could detect that fake ID in an instant.”

NEXT GENERATION APPLICATIONS

With any revolutionary technology, time and imagination must be applied for its full potential to be realized. Visualant and TransTech are working to move ChromaID technology into the smartcard security field, but that’s just a start. Ron Erickson and Tom Furness see chromatic identification as a tool with limitless possibilities. The fields that could see its introduction in the coming years include:

Authentication: The prevention of document fraud and identity theft has become a top priority for governments and corporations worldwide. ChromaID makes it possible to use a hand-held device to verify the authenticity of passports, driver’s licenses, birth certificates, financial documents, personal and bank checks, medical records, academic transcripts, and financial documents.

Law enforcement: Is it cocaine or baking soda? Marijuana or dried parsley? ChromaID technology might become integrated into a law enforcement officer’s flashlight, pen, or smartphone. One flash sends an unidentified substance’s chromatic signature to a national database of controlled substances. Verification of illegality might only be the first step. A growing chromatic database of illicit drugs could begin to yield information about the drug’s place of origin, manufacturing process, and network of distribution.

Industrial: ChromaID’s adaptability – from a wide range of the color spectrum to a sharp focus on a specific wavelength spectrum – makes it an optimal instrument for both identifying industrial materials and maintaining quality control. The chromatic signature of aviation fuel, for instance, allows ChromaID to identify the presence of contaminants such as water, debris, or microbes. Production quality control gets a boost, too: ChromaID can check every unit on a beverage bottling line, on a press run, or an industrial weaving loom.

Agricultural: Spectrophotometers can be used to measure the sugar content in grapes, apples, and other fruit. But they’re expensive and difficult to use – you’ve got to bring the fruit to the lab. Using a handheld ChromaID device, growers could check the sugar levels of their fruit instantly, while it’s still on the vine or tree. Farmers might also use ChromaID for early identification of disease infecting

APPLICATIONS

“When people ask me what is the most interesting application of ChromaID, I tell them the most interesting one is the one I can’t even imagine.” Visualant CEO Ron Erickson

AUTHENTICATION Ink, paper, and plastic are unique. Are these security documents real or forged?

LAW ENFORCEMENT Samples of three white powders. Is one a controlled substance?

INDUSTRIAL Is one of these vodkas diluted? Is the beaker of jet fuel contaminated?

AGRICULTURAL What’s the sugar content of the apple? Are these grapes ready to harvest?

MEDICAL It’s easy to tell the colored pills apart. What are the white pills?

ENVIRONMENTAL Are pollutants in the soil leaching into stream water? Are the salmon eggs compromised?

their crop. Agricultural companies, universities, or extension agencies could compile databases of fungi and viruses known to affect certain species, giving growers an early start in heading off crop loss.

Medical: Dermatologists are interested in ChromaID's potential as a diagnostic tool. The technology may be a great help in measuring jaundice, or in determining the cancerous status of skin lesions. Pharmacists and patients may use ChromaID to verify the authenticity of a medicine. Future versions of ChromaID may be able to measure blood characteristics without the need to poke a hole through the skin.

Environmental: Air, water, and soil analysis becomes vastly more affordable and field-friendly with ChromaID. Spectrophotometry can be used to check for common drinking water contaminants such as arsenic, lead, antimony, nitrates, and nitrites. Air quality measurements – particulate concentrations, industrial emissions, carbon monoxide levels in automobile exhaust – appear as fast as an LED flash. Soil analysis can yield vital information about clay and sand content, pH levels, organic carbon concentration, exchangeable calcium and magnesium, and the presence of iron oxides. ChromaID's ability to fingerprint compounds provides new tracing capabilities through all three media. If it's moving from soil to water, ChromaID can track it.

PUSHING THE LIMITS

Back at the RATLab, the little blue house where it all started, Tom Furness continues to rock and think, rock and think. He's already moved on to the next big-think project...whatever that might be. With Ron Erickson's backing, Furness is experimenting with a medical diagnostic device that uses ChromaID technology to assess a patient's health without invading the skin.

"We're going to build a Tricorder like the one Bones had in 'Star Trek,'" Furness says. His wide grin indicates that he's a little starry-eyed. But his track record indicates that he just might pull it off. "The holy grail for me is to be able to measure blood glucose noninvasively," he says. "It's all about light. We're talking about healing the world with light."

Erickson checks in on Furness now and then. But not often. He knows Furness works better when he's left alone. Besides, he's busy fielding all the incoming ideas about ways to use ChromaID.

"When people ask me what is the most interesting application of ChromaID, I tell them the most interesting one is the one I can't even imagine," says Visualant CEO Ron Erickson.

Learn more about Visualant and ChromaID technology at www.visualant.net

The Glowing Blue House Down the Lane: Inside the RATLab

THERE'S A LITTLE BLUE split-level house in North Seattle that holds the future in its rooms. You'd never know it walking by. The lawn needs mowing and the trim could use a new coat of paint, but that's the way Tom Furness likes it. "This is the skunkworks, the garage, the test kitchen," he says, welcoming a visitor to the RATLab. "It's where I do my 'Rocking And Thinking,' so we called it the RATLab," he explains. "I've always wanted a lab where I could just hire a few folks and look at issues and come up with solutions. Build stuff. Try out stuff."

When Ron Erickson offered to fund a lab to investigate the ideas that developed into ChromaID, Furness considered renting an office. But he needed different rooms for different tools and projects. "This type of equipment," he says, blowing dust off a chop saw, "doesn't mix well with things like semiconductors."

He saw a house for sale, did the math, and bought it. The living room now houses a conference table, three whiteboards, and an advance video conferencing system. One bedroom holds spectrophotometers and early ChromaID prototypes. Another is packed with video systems and a light table. Bits and pieces of wire and plastic speckle the hallways. The kitchen is – well, a kitchen. An inventor's got to eat.

Rocking And Thinking: Tom Furness in front of the RATLab

The neighbors don't complain, but Furness admits the house does attract visitors who come and go at odd hours. And then there are the strange lights – there's been a lot of flashing going on behind those closed blinds. "So far we've got four patents out of this old house, and two more are pending," says Furness. "It may not look like much, but for what we do it's perfect."