the institute

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SPECIAL REPORT

THE NEXT WAVE OF WEARABLES

IEEE

Calendar & IEEE Events

June

5
1833
Computer pioneers **Ada Lovelace** and **Charles Babbage** meet for the first time. They would later collaborate on the Analytical Engine, an elaborate calculating machine.

10
1918
Birth date of IEEE Fellow **Louis F. Moose**, a radar pioneer who worked on microwave relay communications systems at Bell Labs.

20
IEEE Honors Ceremony in New York City.

21–22
IEEE Meeting Series in New Brunswick, N.J.

23
1943
Birth date of IEEE Fellow **Vinton Cerf** [above], coinventor of the protocols that enable computers connected to the Internet to communicate with each other.

July

4
1968
NASA launches **Explorer 38** [above], the first radio astronomy spacecraft, which measured galactic radio sources and studied low frequencies in space.

9
1847
Birth date of **Edwin James Houston**, inventor of an arc street-lighting system and president from 1893 to 1895 of the American Institute of Electrical Engineers, one of IEEE's predecessors.

12
1854
Birth date of **George Eastman** [above], cofounder of photography company Eastman Kodak.

18
1968
IEEE Fellow Gordon Moore and Robert Noyce found **Intel**.

21
1970
The **Aswan High Dam** in Egypt [above] is completed.

August

10
1885
The **first commercial electric streetcar** in the United States goes into service in Baltimore.

17
1937
The British Royal Air Force tests the **first airborne radar set**.

19
1906
Birth date of **Philo T. Farnsworth** [above], inventor and television pioneer.

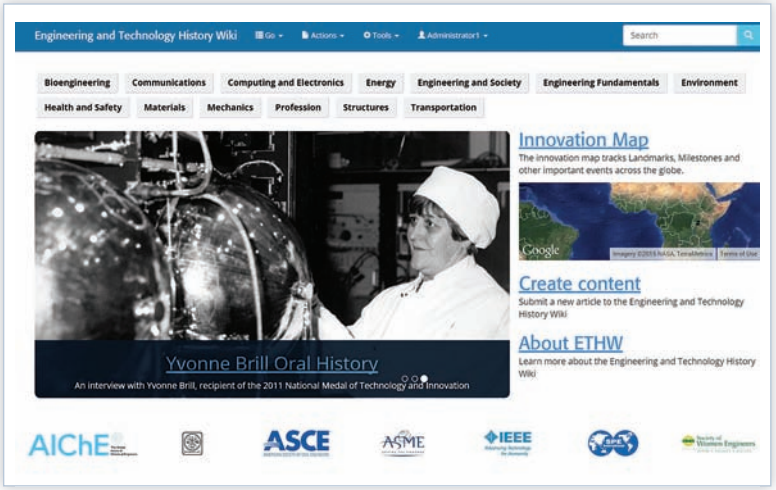
24
1995
Microsoft releases its **Windows 95** software. The company would go on to sell nearly 7 million units in the first six weeks.

28
1964
NASA launches Nimbus [above], the **first weather satellite** to transmit nighttime cloud photos.

Historical events are provided by the IEEE History Center. For photos and videos of these engineering milestones, visit http://theinstitute.ieee.org/briefings/calendar.

FROM TOP: GSFC/NASA; BETTMANN/CORBIS; ISTOCKPHOTO; GAMMA-KEYSTONE/GETTY IMAGES; SYGMA/CORBIS; VENI MARKOVSKI/WIKIPEDIA; NASA; AFP/GETTY IMAGES

BRIEFINGS



Wiki Documents the History of Engineering

THE IEEE GLOBAL History Network is, in fact, history. The GHN has been replaced by the new Engineering and Technology History Wiki (ETHW), which features content from the IEEE History Center as well as historical material produced by six other technical societies.

You can visit the wiki at http://www.ethw.org, where you'll find several thousand articles, more than 600 oral histories (interviews with pioneers in their fields), 200 memoirs, thousands of archival documents, and hundreds of hours of audio and video. While the GHN focused on the history of electrical engineering, the ETHW seeks to capture the history of each engineering discipline of its member societies.

"This broader scope allows us to better serve our mission of educating the public by reaching many more potential readers," says Michael Geselowitz, the center's senior director.

The site is managed by the IEEE History Center as well as the American Institute of Chemical Engineers; the American Institute of Mining, Metallurgic, and Petroleum Engineers; the American Society of Civil Engineers; the American Society of Mechanical Engineers; the Society of Petroleum Engineers; and the Society of Women Engineers. More engineering societies are being encouraged to contribute.

The ETHW is funded by the United Engineering Foundation, which provides grants for engineering outreach and education programs. *—Amanda Davis*

INSIDE

ONLINE

Available 5 June at theinstitute.ieee.org

TECH HISTORY The first CT scan was generated 50 years ago.

E-BOOKS ON E-HEALTH A variety of titles are offered in the IEEE Xplore Digital Library.

IN MEMORIAM IEEE mourns the loss of three of its members.

Remember to Vote in the Annual Election

LOOK FOR YOUR annual election ballot package to arrive in August via first-class mail with a ballot and postage-paid reply envelope. You'll

COVER: CHAD HAGEN; THIS PAGE: ENGINEERING AND TECHNOLOGY HISTORY WIKI

also receive instructions via e-mail, explaining how you may access and return the ballot electronically.

Those eligible to vote include new members as of 30 June and students elevated to member or graduate student member grades on or before that date. Associate members are not eligible to vote.

To be a member, you must be regularly employed in an IEEE-designated field and have a combination of education and work experience totaling at least six years. You can apply online for transfer to member

grade. To be eligible to vote, student members graduating this year between 1 January and 30 June must update their education information online to be elevated to member or graduate student member grade.

Log in to your IEEE account by 30 June and confirm or update your contact information, member preferences, and education information. That will help guarantee you receive your ballot package.

ELECTION DEADLINES

17 AUGUST

Date by which IEEE annual election ballots will be mailed to voting members and electronic ballots will be made accessible.

1 OCTOBER

Last day that members' marked ballots can be accepted by IEEE, by noon CDT USA/17:00 UTC.

15 OCTOBER

Election results are announced by the IEEE Tellers Committee.

22-23 NOVEMBER

IEEE Board of Directors acts to accept the report of the Tellers Committee. Election results are made official. —*Carrie Loh*

ISTOCKPHOTO

REGION NEWS

REGION 1 — NORTHEASTERN UNITED STATES

- Student branch at the **University of Connecticut, Mansfield,** forms IEEE Engineering in Medicine and Biology Society chapter.
- **North Jersey Section** forms joint chapter of IEEE Electromagnetic Compatibility and IEEE Product Safety Engineering societies.

REGION 2 — EASTERN UNITED STATES

- **Cleveland Section** forms IEEE Consultants Network affinity group.
- Student branch at the **University of Dayton, Ohio,** forms IEEE Women in Engineering (WIE) affinity group.

REGION 3 — SOUTHEASTERN UNITED STATES

- Student branch at **Auburn University, Alabama,** forms IEEE Industry Applications Society chapter.
- Student branch at **Georgia Tech** forms IEEE Computer Society chapter.
- **Central North Carolina Section** forms joint chapter of IEEE Communications and IEEE Signal Processing societies.
- Student branch at **Clemson University, South Carolina,** forms IEEE Intelligent Transportation Systems Society chapter.

REGION 4 — CENTRAL UNITED STATES

- Student branch at **Concordia University, Chicago,** forms IEEE Computer Society chapter.
- Student branch formed at **Ball State University, Muncie, Ind.**

REGION 5 — SOUTHWESTERN UNITED STATES

- **Denver Section** forms IEEE Industrial Electronics Society chapter.

REGION 6 — WESTERN UNITED STATES

- Student branch at **Arizona State University, Phoenix,** forms IEEE Power & Energy Society chapter.
- **San Francisco Section** forms IEEE Computer Society chapter.

REGION 7 — CANADA

- Student branch formed at **Kwantlen Polytechnic University, Surrey, British Columbia.**
- **Quebec Section** forms WIE affinity group.

REGION 8 — EUROPE, MIDDLE EAST, AND AFRICA

- Student branch formed at **Cyprus University of Technology, Limassol.**
- Student branch formed at **Akhbar El-Yom Academy, 6th of October City, Egypt.**
- Student branch at the **University of Bordeaux, France,** forms IEEE Antennas and Propagation Society chapter.
- **Germany Section** forms IEEE Aerospace and Electronic Systems Society chapter.
- Student branch at the **University of Jordan, Amman,** forms IEEE Robotics and Automation Society chapter.
- Student branch formed at the **Holy Spirit University of Kaslik, Jounieh, Lebanon.**
- Student branch formed at **Middle East College, Muscat, Oman.**
- Student branch formed at the **National School of Sciences and Advanced Technology, Tunis.**

REGION 9 — LATIN AMERICA

- **Minas Gerais (Brazil) Section** forms IEEE Power & Energy Society chapter.
- Student branch at **Pontificia University Catolica de Minas Gerais, Brazil,** forms WIE affinity group.
- Student branch formed at **Universidade do Estado de Mato Grosso, Brazil.**
- Student branch at **Universidade Federal do Vale do São Francisco, Petrolina, Brazil,** forms IEEE Electron Devices Society chapter.
- Student branch at **District University of Bogotá** forms IEEE Power Electronics Society chapter.
- Student branch at **Universidad de Costa Rica, San José,** forms IEEE Power & Energy Society chapter.
- **Ecuador Section** forms IEEE Computer Society chapter.
- Student branch at **Universidad Don Bosco, San Salvador,** forms IEEE Robotics and Automation Society chapter.
- **Puebla (Mexico) Section** forms IEEE Young Professionals (YP) affinity group.
- **Peru Section** forms IEEE Microwave Theory and Techniques Society chapter.

REGION 10 — ASIA AND PACIFIC

- **New South Wales (Australia) Section** forms IEEE Vehicular Technology Society chapter.
- Student branch at **Sydney University of Technology** forms IEEE Systems, Man, and Cybernetics Society chapter.
- Student branch formed at **University of Dhaka, Bangladesh.**
- **Beijing Section** forms chapters of IEEE Intelligent Transportation Systems and IEEE Robotics and Automation societies.
- **Kerala (India) Section** forms IEEE Circuits and Systems Society chapter.
- **GH Patel College of Engineering and Technology, Vidyanagar, India,** forms WIE affinity group.
- **Islamabad (Pakistan) Section** forms YP affinity group.
- **Tokyo Section** forms chapters of IEEE Nuclear and Plasma Sciences and IEEE Photonics societies.
- **Singapore Section** forms IEEE Intelligent Transportation Systems Society chapter.

SEND US YOUR NEWS *We announce the formation of new groups once they've been approved by IEEE Member and Geographic Activities. To send us local news, like student branch events and competitions, WIE or preuniversity outreach efforts, or other IEEE group activities, use our form on the Region News page at http://theinstitute.ieee.org/region-news.*

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SPECIAL REPORT

THE NEXT WAVE OF WEARABLES

WHILE WEARING FITNESS TRACKERS *has become a popular trend, many people believe their real value lies in the devices' ability to monitor not just steps taken but vital signs as well. For that application, the gadgets have a long way to go. The devices and their apps are not that accurate and don't monitor enough fitness metrics. Most trackers contain relatively few sensors and are limited as far as where they can be worn on the body. And their batteries must be constantly recharged. This special report describes efforts to make wearables work better by building a platform with sensors that accurately measure blood pressure, heart rate, and even the sort of airborne pollutants that can cause breathing problems [this page]. These units are built on flexible materials, so they can be worn just about anywhere on the body. What's more, they don't need batteries but instead run on energy harvested from the wearer's movements.*

One article tackles another problem with today's wearable trackers: They not only do too little but also fall short in motivating their users to do more [p. 6]. Once the goals for the day are reached, there's not much to motivate users to take charge of other aspects of their health. But one specialist with a background in experimental psychology shows how games and social media can help inspire users on a subconscious level to be more health conscious.

With all the effort directed to develop new and improved medical devices, engineers are needed more than ever. The IEEE Life Sciences Technical Community predicts that the number of jobs in the life sciences will expand dramatically over the coming years. In this issue, we highlight the skills needed for engineers to enter this interdisciplinary field [p. 7]. We've also rounded up some of the resources and conferences that IEEE offers on electronic health, or e-health [p. 15].

And we profile IEEE Senior Member Joel Rodrigues, who is developing the networking technologies that will make e-health applications possible [p. 17]. His work involves wireless and body sensor networks, mobile and cloud computing, and information management.

And speaking of the future, we also includes a Q&A with the two 2016 IEEE president-elect candidates, Senior Member Karen Bartleson and Life Fellow Frederick "Fred" Mintzer, about their plans to take the organization to the next level [p. 8].

—Kathy Pretz, editor in chief

Health Monitors Get More Personal

Self-powered sensors are being integrated into fabric BY KATHY PRETZ

WEARABLE HEALTH and fitness trackers are among the most popular gadgets around. More than 13 million of them were sold globally last year, according to GfK, a German market research firm. And these numbers are only expected to grow as more sophisticated versions hit the market, with claims that they can monitor vital signs such as blood pressure, heart rate, and even hydration levels.

But a few problems with activity trackers must be addressed before they can be used as medical monitors. Trackers tend to contain too few sensors, must be charged frequently, and can only be worn on the wrist or clipped to clothing. And perhaps most troubling, they aren't accurate enough.

"Their level of accuracy is low because as a consumer product they haven't gone through the rigorous regulatory approval of medical devices," says IEEE Fellow Veena Misra. "But users want this type of technology."

Misra is director of the U.S. National Science Foundation Nanosystems Engineering Research Center for Advanced Self-Powered Systems of Integrated Sensors and Technologies, better known as ASSIST. The center is located at North Carolina State University, in Raleigh, where she is also a professor of electrical and computer engineering. She is the lead author of "Flexible Technologies for Self-Powered Wearable Health and Environmental Sensing," published in April in *Proceedings of the IEEE*.

ASSIST, led by NC State, is a joint effort with Florida International University, Pennsylvania State University, and the University of Virginia. The center is using nanotechnology to build clinically accurate health-monitoring platforms and technologies that are self-powered and can be used on different areas of the body. ASSIST is working with several partners, including hospitals and medical device makers. According to Misra, the center will create the platform, and the partners will develop the products.

"The center's vision is to develop and integrate the technology in the direction of accurate, data-driven health management," she says. "We believe this is the requirement for improving global health care and quality of life."

ELECTRONIC TEXTILES

Most of today's wearables fit the electronics in wristbands, which rely on batteries that require periodic charging. ASSIST is developing novel flexible materials that conform to the body and can include a variety of sensors that can perform tasks such as checking vital signs and detecting particulates in the environment. And they can be worn on different parts of the body. What's more, the devices can be powered by energy harvested from the movement of the wearer's body. Batteries are no longer needed.

For example, ASSIST has developed a piezoelectric-coated film on nickel foil encapsulated in kapton tape that can scavenge energy from the movement of a person's elbow. Piezoelectric-coated fibers or nanowires woven into an athletic compression shirt, for instance, could generate power every time the wearer moves, according to ASSIST researcher Jesse Jur. An assistant professor of textile engineering, chemistry, and science at NC State, Jur is also one of the authors of the *Proceedings* article.

When the elbow bends, the device stretches, generating a current. Another wearable monitoring system uses inexpensive and highly stretchable and recoverable polymer films

CHAD HAGEN

ASSIST researchers are working on ways to weave electronics into garments, like this armband worn on the elbow, that can harvest thermal and mechanical energy generated by body heat and motion. This energy can be used to power wearable medical devices.

ASSIST/NC STATE UNIVERSITY

woven into compression fabrics that integrate microelectronic devices and printed circuits.

"It's important to have a material that is flexible and stretchable over the skin so it's comfortable but at the same time provides good electronic access to the skin," says Misra.

Adds Jur, "We're also working on durable ways to interconnect hard electronics placed at different locations on garments so they can communicate with each other. Textiles are typically inexpensive, and printed electronics technologies are getting a lot cheaper, so we are trying to integrate the two in a seamless manner."

HARVESTING POWER

ASSIST is focused on harnessing renewable sources of power for the tiny devices from body heat (which creates thermal energy) and body motion (which creates mechanical energy), says Misra.

For local transfer of thermal energy to usable power, ASSIST researchers have been exploring thermoelectric energy generators (TEGs). These devices rely on the Seebeck effect, in which a temperature gradient across a material causes diffusion of charge carriers from the hot to the cold side. This creates a separation of charge within the material and, as a result, a voltage.

When a thermoelectric material is placed between hot and cold surfaces, power is generated. Where the TEG is placed on the body is important. The transfer of heat to electrical energy requires efficient heat collection from the body at one point and efficient heat rejection to the outside environment at another, with some kind of thermal insulation between the two. Today's body heat–harvesting devices are limited because they are made of rigid ceramic plates, unable to maintain good skin contact in curved areas of the body.

"To harvest heat from the body, you must make intimate contact with the skin, and for that you need very good heat spreaders in the form of thermal electric material and a good heat sink on the other end to provide the 'cold' side of the generator," Misra says. "This approach will basically get us away from using a battery."

For their wearables, the researchers are targeting power levels as high as 500 microwatts to power multiple sensors and their electronics.

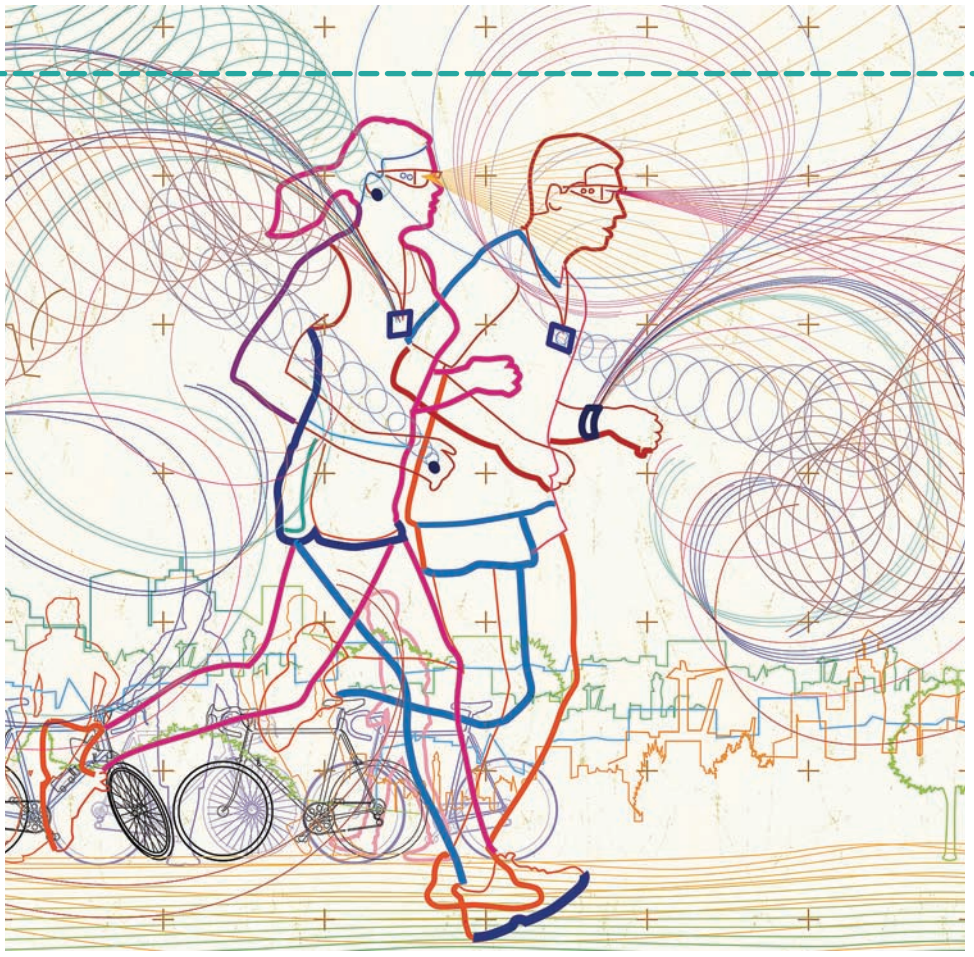
The ideal place for a TEG is on a person's pulse points, where blood vessels are close to the skin's surface. That's why textiles play a critical role: They conform to the body and provide the thermal insulation to maintain a temperature difference.

PROTOTYPES

The center has created a flexible wristband made of polymers integrated with components that include a TEG, low-power chips, and a low-power radio. It has also built a wireless, wrist-worn platform that includes sensors for measuring vital signs such as arterial blood pressure and blood oxygen saturation as well as tracking airborne pollutants. "Innovation lies in making these things truly wearable all the time," Misra adds. ◆

The Psychology Behind Wearables

It takes more than data to get users motivated BY MONICA ROZENFELD



IF YOU'RE LIKE ME, you've probably bought a wearable that tracks your steps in hopes it will inspire you to walk more. And if you're also like me, you learned quickly what it takes to reach your daily goal and started leaving your gadget collecting dust in a drawer.

This is not a unique scenario. According to Endeavor Partners, a market researcher, while at least 1 in 10 Americans over the age of 18 owns a tracking device like the Fitbit or Nike Fuelband, more than a third of those who get them abandon them within a few months. The reasons given include meaningless stats, poor design, and loss of interest.

Elizabeth Churchill, a specialist in user experience with a background in experimental psychology, is studying how to go beyond the data wearables gather to motivate people on a subconscious level to take charge of their health. She is coauthor of "Wellth Creation: Using Computer Science to Support Proactive Health," published last November in IEEE's *Computer* magazine, which can be downloaded from the IEEE Xplore Digital Library.

"Humans have complex motivational systems," she says. "If designers of wearables don't understand people on a holistic level, then they create devices that won't work over the long term for the majority of users."

MISLEADING MOTIVATION

The popularity of wearable trackers in the past few years is partly due to outside incentives: for example, employers providing a discount on medical insurance premiums or competition among colleagues for a prize. "These are examples of coercion in the best sense of the word," Churchill says. But once the incentive is gone, it's difficult for users to keep up the same level of engagement.

"If I go running, I'm doing so because I want to be fit and healthy. I run because I want to feel good, fit into a smaller dress size again, breathe fresh air, and see my neighborhood," she says. "There are many levels of motivation that are not about how many steps I took or if I get a discount." Because wearables simply present a number, the data alone is often not meaningful enough to keep people devoted to their devices.

MAKING FITNESS FUN

To learn what actually makes people tick, Churchill and other researchers are taking cues from gaming and social media.

Take the Zombies, Run! app. A team that included a science fiction writer, a game developer, and a personal trainer designed it to motivate people to "run for their lives." Its more than 800,000 users plug in their headphones and listen to a narrative that warns them when zombies are hiding behind trees or trailing them. It then instructs the runners to pick up speed or slow down and even tells them how to collect virtual medicine or weapons as they run. When the run is over, users can view a map on their devices of the route they took and see where the zombies were. They can then use the supplies they collected to play a virtual game.

"Gyms try to do something similar by installing TVs in front of the treadmills or playing music as an attempt to turn something that doesn't feel pleasurable into something that is at least tolerable," Churchill says. Wearables may try to do this by rewarding users with badges for their hard work, but people tire of this tactic fairly quickly, she says.

While not everyone is a gamer, she points out, Zombies, Run! and apps such as Ingress, which uses GPS coordinates to inspire people to move around their neighborhoods in a game they can play on their smartphones, can provide invaluable lessons. "Humans are natural storytellers, and these apps makes them part of the story," she says. "They're immersive. You want to keep going." They not only track what users have already accomplished—they also help them gradually improve by encouraging them to take on a more difficult path or run longer or faster.

This isn't happening with wearable trackers, whose users tend to stop being active once they reach their original goals. Some feel using their trackers is a chore, Churchill says, while others say they feel enslaved by them.

PEER PRESSURE

While gaming can have a big impact on engagement levels, so can social media. One way is by tapping into niche online communities, such as those for working mothers or people training for a 5K race. Some people will announce a personal health or fitness goal on Facebook. These social platforms—whether they're made up of strangers striving for the same objective or friends and family—help make people feel accountable.

Moreover, collecting information from these sites' events calendars, which may include the date of an upcoming local race or a high school reunion, can add an extra layer of motivation by reminding users of what they are striving to accomplish and how much time they have left to do it.

"People make commitments, to themselves and others, and wearables can be better designed to help them stick to their goals," Churchill says. ◆

GUIDO ROSA/CORBIS

The Life Sciences Offer Opportunities for Engineers

The field requires people who know automation, imaging, and product safety BY JOHN R. PLATT

AN APPLE A DAY IS said to keep the doctor away, but nowadays doctors are more likely to keep their patients healthy with an Apple device instead. Doctors are using mobile gadgets outfitted with diagnostic software and wirelessly synced medical equipment to monitor their patients' health at any time.

"Medicine is not practiced the way it used to be," says IEEE Fellow Donna Hudson, chair of the IEEE Life Sciences Technical Community (LSTC), which includes members from the IEEE Engineering in Medicine and Biology Society, five other IEEE societies, and other groups involved in related sciences.

"Medicine has become even more complex," Hudson says. "To advance, the field needs people who understand automation, computing, diagnostics, imaging, product safety, and other technologies."

In other words, medicine needs IEEE members.

E-HEALTH ON THE RISE

Engineers are needed in nearly every area of the life sciences, including biomedical engineering and genomics, according to Nahum Gershon, an LSTC steering committee member representing the IEEE Consumer Electronics Society. He is a senior principal scientist with Mitre, a not-for-profit company based in McLean, Va. Mitre operates federally funded R&D centers for the U.S. government in such areas as systems engineering, signal processing, and mobile technology.

"Medicine is becoming more and more reliant on electronic devices," he says. "Instruments and medical-imaging technologies are used in almost every aspect of routine medical work. Surgeons are able to implant devices in the human body that deliver medication, monitor body functions, and provide support to organs and tissues."

Some of these devices, in combination with wearable technology, can function as part of a network of sensors, actuators, and other mobile-communication devices—collectively known as the Internet of Things—that can continuously monitor the state of a patient's health. "These connected health care technologies are poised to revolutionize areas such as home care and the tracking of diseases that include hypertension, diabetes, allergies, and asthma," Gershon says.

GETTY IMAGES

None of this would be possible without high-tech professionals. "Doctors need to understand and cope with all these different technologies, and engineers and scientists can make things simpler for them," he adds.

Take the Human Genome Project's mission to map and identify in its entirety the genetic material of humans. "All the information now at the doctors' disposal has led to an overload of data to analyze, which is in contrast to what they used to have: not enough information," says Gershon. "They need the help of sophisticated computers and data scientists to deal with it."

And as the technologies continue to move ahead, societal changes will open up even more opportunities.

JOBS IN DEMAND

With aging populations worldwide, a growing middle class in developing countries, the desire to ameliorate chronic illnesses such as diabetes, and increased government spending on health care, the LSTC predicts that the number of life sciences jobs around the world will expand dramatically over the coming years.

The LSTC recently calculated that 1.1 million people in the United States are already employed in R&D in the life sciences. The pharmaceutical and medical manufacturing sector employs another 270,000 people. And there are hundreds of thousands more in genetic testing, biotechnology, and nanotechnology. In many fields, employment over the past 15 years has more than doubled.

Recent listings on job boards for life sciences–related positions include corporate and academic openings for software engineers, imaging technologists, quality-control specialists, automation engineers, systems engineers, and numerous other related professionals.

These fields, it should be noted, pay extremely well. The LSTC found that in 2012—the most recent year for which numbers are available—the pharmaceutical and medical manufacturing sector had one of the highest average annual salaries in the United States, at US $110,000.

GETTING IN

Hudson and Gershon agree that just about anyone already working in technology could move over to the life sciences, although it's helpful to have a working knowledge of biology. That's easy enough to gain by taking a few introductory courses in biology, anatomy, cell biology, and epidemiology. Gershon recommends online resources available through the Harvard University Online Learning program.

For some areas—such as medical informatics, which combines medicine and computing—getting a doctorate or master's in biology or a related field may be necessary. For those unsure of which area of the life sciences to pursue, it is helpful to talk to those working in different aspects of medicine to learn more about their industry. Another option is to participate in seminars and meetings for life sciences and health care professionals at local hospitals, universities, and research institutions.

Hudson says engineers have a huge advantage when moving into the life sciences, because although doctors may understand which medical problems they want to solve, they might not have the technical know-how to accomplish their goals. "And the engineering part is just too difficult for them to learn in a short time frame," she says. ◆

The Candidates' Plans for the Future of IEEE

Bartleson and Mintzer vie for 2016 IEEE president-elect

BY **MONICA ROZENFELD**

RICK OLIVIER

THE ANNUAL IEEE election process begins in August—be sure to check your mailbox that month for your ballot. To help you decide whom to choose for 2016 IEEE president-elect, we interviewed the candidates: IEEE Senior Member Karen Bartleson and IEEE Life Fellow Frederick "Fred" Mintzer. Here they speak of why they first joined the organization and their goals for its future.

First, some background. Bartleson is senior director of corporate programs and initiatives at Synopsys, an electronic design automation company, in Mountain View, Calif. Her responsibilities include creating programs for technical standards development and software tool interoperability, building relationships with universities and research institutions worldwide, and engaging customers with social media. She joined Synopsys in 1995 as manager of its standards group and was director of quality from 2000 to 2002.

Bartleson received the 2003 Marie R. Pistilli Women in Electronic Design Automation Achievement Award. She also authored a book, *The Ten Commandments for Effective Standards: Practical Insights for Creating Technical Standards*, published in 2010 by Synopsys Press.

She was president of the IEEE Standards Association in 2013 and 2014. During her term, she led the development of a new strategic plan; furthered OpenStand, a set of principles for developing global standards; and finalized IEEE's membership in the Global Standards Collaboration, a volunteer group that promotes collaboration in communications standards development.

As a member of the IEEE Board of Directors in 2013 and 2014, Bartleson chaired and led the development of the strategic plan for the IEEE Internet Initiative Committee, which aims to boost IEEE's influence in Internet governance, cybersecurity, and privacy policy [see p. 11]. She was also a member of the IEEE Strategic Planning Committee, overseeing the development of IEEE's role in global public policy.

Mintzer joined IBM in 1978 and spent the early part of his career investigating signal and image processing. He later managed projects that developed image-based digital library technologies and applied them to joint projects with museums and libraries, including the Egyptian Museum, in Cairo; the State Hermitage Museum, in St. Petersburg, Russia; and the Vatican Library, in Vatican City. From 2001 to 2005 he was senior manager of IBM's visual technologies department, which worked on computer graphics, data visualization, and digital imaging.

From 2005 to 2013 he was program director for IBM's Blue Gene Watson supercomputer facility and associate director of its Deep Computing Institute, both at the company's T.J. Watson Research Center, in Yorktown Heights, N.Y. He retired on 1 January 2014.

Mintzer holds more than 25 patents and has written more than 50 technical papers. He was twice named an IBM Research Master Inventor.

He was vice president of IEEE Technical Activities in 2012 and director of Division IX in 2008 and 2009. He was 2009 chair of the IEEE Employee Benefits and Compensation Committee and has served on many other committees, including the IEEE Nominations and Appointments, Governance, and Investment committees. In 2009 he served as Region 1 liaison to the IEEE Technical Activities Board.

Mintzer was president of the IEEE Signal Processing Society in 2004 and 2005. As president, he helped launch the society's *IEEE Transactions on Information Forensics and Security* publication. Mintzer was a candidate for IEEE president-elect in last year's election.

Why did you first join IEEE? And what has been your favorite project with the organization?

BARTLESON

I joined IEEE as a student because I was encouraged by one of my professors to become a member. He explained that IEEE was a great organization that could help me develop my career and make professional connections. He was certainly right.

The most rewarding project I worked on with IEEE is also my most recent. Along with many dedicated expert members, I contributed to the latest update of the IEEE Standards Association's patent policy [see p. 14], which was approved by the IEEE Board of Directors in February. It is my favorite project because it was difficult and challenging; it solved real problems faced by industry, judicial systems, and consumers; it will have a global impact as an example of IEEE's growing involvement in public policy; and it directly supports IEEE's mission to advance technology for humanity.

It allowed me to work across IEEE and to help lead a globally significant accomplishment.

MINTZER

I first joined IEEE in 1975. I was a graduate student and came to understand that belonging to IEEE was an important part of being a member of the engineering profession.

Perhaps my favorite project has been *IEEE Technical Community Spotlight*, a digital magazine that republishes articles on emerging technologies from 41 IEEE society and council magazines with information on how to become involved in those areas. I helped create *Spotlight* while I was vice president of Technical Activities in 2012 and currently serve as its editor in chief, selecting which articles to republish.

This project gives me the opportunity to learn about emerging technologies, which I love. It also gives me the ability to target the interests of the broader IEEE membership, which includes industrial employees and young professionals. It also allows me to experiment with new ways of communicating with IEEE audiences—one of the great challenges of this social-media era—and the chance to collaborate with some wonderfully talented and enthusiastic colleagues.

Which IEEE services and benefits do you use the most, and why?

MINTZER

My professional interests are centered on new technologies and where they will take us. IEEE magazines, which include those produced by IEEE's technical societies, *IEEE Spectrum*, and *The Institute*, are a prime source of my information. All are technically sound and well curated and they are often organized as topical issues, which adds valuable perspective.

Beyond the magazines, I am very interested in the thoughts of colleagues working on emerging technologies. Consequently, I am an enthusiastic member of several IEEE online emerging technology communities and of several communities piloted in IEEE Collabratec for technology professionals working in common fields of interest. Collabratec will provide a suite of online tools with which to network, collaborate, and create—making publishing faster and easier.

BARTLESON

As a professional and an employee of Synopsys, IEEE standards are the most important IEEE offerings that I use. I've led Synopsys's standards program for 20 years, helping make our business successful while meeting our customers' demands for interoperable products. IEEE standards are crucial to the electronic design automation industry and, in turn, the whole semiconductor industry.

Personally, I've benefited from IEEE's insurance programs and educational resources. From free e-books to IEEE conferences to *Spectrum* magazine, IEEE continues to offer valuable information that enables me to do a better job and stay current on technology trends.

In the future, we will all benefit from IEEE's involvement in global public policy efforts such as the Internet Initiative, which I spearheaded as the volunteer lead. The initiative is bringing technologists into Internet governance, cybersecurity, and privacy policy, where our expertise is sorely needed.

If you had only 30 seconds to tell people about why they should volunteer for IEEE, what would you say?

BARTLESON

Here are three important reasons why you should volunteer with IEEE: You will enhance your technical skills and visibility by working in areas of emerging technology and by publishing your work products, cultivate an enduring support network of professional connections, and fulfill your sense of social responsibility.

MINTZER

Through volunteering, you will receive much more than you give. Interacting with IEEE colleagues will help you stay technically current. You will also have great opportunities to grow your leadership and communication skills, and develop a global perspective. Also, volunteering will provide opportunities for you to serve the profession and humanity in ways not open to those not part of the organization.

Many members see continuing education as a way to stay relevant in today's ever-changing industries. How will you help members get the resources they need to stay ahead of the curve?

MINTZER

Many members currently receive the information they need to stay relevant—and we should continue to provide it. However, I also believe IEEE should do more to serve members working in the private sector. Those members should anticipate having several minicareers during their working life and should always be preparing for their next job.

They need information that is concise and well curated to fit into their busy schedules while targeting the job skills they need. I would establish practitioner and entrepreneur communities with our Collabratec platform. I would refocus online efforts on webinars and technology updates to provide more educational value for members in industry.

I would also continue to focus on emerging technologies, which will be at the center of tomorrow's jobs. All IEEE members benefit from having more information on these topics. I would strengthen our ties to industry so we don't lose our connection to the new technologies that are at the heart of the tech industry.

BARTLESON

IEEE offers a variety of continuing education resources for our members. It's most important to raise the awareness of these resources to members and potential members. I will do this through my support of IEEE's Public Visibility Committee, during encounters with members in large gatherings or with individuals one on one, and at every opportunity I have to present IEEE to industries, academic institutions, and governments around the world.

The follow-on to increased visibility is giving feedback to IEEE about what is working and suggestions from members for improving our continuing education resources.

Over the past 15 years the percentage of women members has held at about 10 percent. What ideas do you have to recruit more women to join IEEE?

BARTLESON

This is a complex issue—more complex, I'd say, than designing a 10-billion-transistor IC. For the past 40 years, from the time I was a student, the percentage of women I've observed in my profession has remained around 10 percent. This also reflects the number of women who are members of IEEE. Before we can recruit more women to join IEEE, however, we need more women in the profession to begin with. This starts by bringing more girls into the fields of science, technology, engineering, and math (STEM).

I've read countless theories about why girls have not been attracted to STEM. No one has been able to come up with a solid explanation to my satisfaction. Indeed, some theories are downright ridiculous. In my travels, I observed significantly


Bartleson

more girls studying STEM in universities outside of the United States. The problem in these countries is that once graduated, the young women do not stay in STEM but instead pursue family life or other interests. So the challenge is twofold: How can we appeal to girls to concentrate on STEM studies and then keep them in industry and academia after graduation?

STEM has been misrepresented as sterile—lots of mathematical equations with antisocial brainiacs for colleagues. What excited me when I learned that the field of engineering existed was that I could actually make things that would help the human condition.

This aspect of STEM is certainly appealing to anyone who wants to choose a path in which one's life can really matter. If we can get this message out to girls and young women all over the world, I am hopeful that the number of women in STEM will swell and the percentage of female members in IEEE will grow accordingly.

MINTZER

When I have attended IEEE Women in Engineering Leadership meetings, I heard that women have often not been welcomed into the tech industry. IEEE's women leaders need to be able to share experiences with their colleagues to better deal with workplace problems and create a more welcoming environment for the next generation of women tech professionals. We should expand the venues to do this.

I also support creating other venues that focus on young professional women who are now entering the tech workplace. They would greatly benefit from mentorship by their predecessors and from opportunities to share one another's experiences they have found beneficial.

I believe we learn most from colleagues when we are working together. I would encourage IEEE women members to jointly undertake activities that educate preuniversity women about the opportunities in the tech industry, which is changing the world in many positive ways.

In February, The Institute *highlighted several IEEE projects in developing and underserved nations. What would you say is one of the biggest causes that IEEE can help with?*

MINTZER

It is important to make better use of the world's resources—air, water, and energy—and its people. All satisfy vital needs. Technology can be used to do this, as shown in IEEE's work on smart cities, smart villages, and humanitarian projects. Improving the utilization of these resources, for those who rely on them, is the big cause that IEEE should address.

However, addressing problems in developing nations involves more than solving technical problems. Sustainable solutions require building a community with local members who understand the technology and the local culture and can call on technical expertise from around the world; a means of communication to bring that community together; and energy to power that form of communication and any technology delivered. Building such a sustainable infrastructure should be a first step when IEEE addresses a problem in an underserved nation. The scope of IEEE uniquely qualifies it for this task.

BARTLESON

From Argentina to Zimbabwe, IEEE puts into practice our mission of advancing technology for humanity. Underlying every project is at least one IEEE standard. Our standards serve causes such as smart grids that bring electricity to more people. Standards also enable Internet access in remote areas. Even disaster prevention and relief rely on IEEE's safety standards. Rather than choose a single cause, I'd say expanding our global standardization efforts helps with all causes simultaneously. And that's powerful.

If you had to write a strategic plan for IEEE for the next three years, what three items would it include?

BARTLESON

I actually worked on IEEE's strategic plan last year as a member of the Strategic Planning Committee. Building on foundational work done previously, the committee identified and refined items for the IEEE strategic plan to focus on. Three of these items are supporting the technology life cycle, the role of IEEE in participating in global public policy activities (which I was assigned to), and coordinating strategies across IEEE. These align with the priorities of IEEE, which are essential to our strategic plan.

MINTZER

One element would be to continue enhancing our forthcoming Collabratec collaboration tool so that it enables greater collaboration among IEEE members in geographic, technology-centric, career-based, and volunteer-based communities.

A second element would be to increase our efforts in emerging technologies. They strengthen our connection to industry and help members prepare for tomorrow's jobs.

A third element would be to enhance the activities and services we provide in regions outside the United States to better serve IEEE members around the globe.


Mintzer

What must IEEE do to stay relevant?

MINTZER

IEEE needs to quickly recognize and embrace emerging technologies, which are the centers of excitement in our profession and centers of future job growth.

IEEE needs to act more globally so it is more relevant to all its members. Being more aware of local technical needs so they can be served is part of this. Humanitarian and emerging technology projects are part of this, too, demonstrating as they do IEEE's global interests better than words. Enabling non-English speakers to better participate in our communities is yet another part of it.

IEEE also needs to transform the way it communicates with its members. We need to master social networking to increase the interactivity of our communications and move away from providing static content to providing a forum for discussions. Social media makes this possible and is especially attractive to IEEE Young Professionals, who are adept at this form of communication.

BARTLESON

IEEE must stay relevant in our ever-changing world, not only technologically but also socially, economically, and culturally. IEEE must recognize, embrace, and deploy change to provide ongoing value and service to our diverse membership. We can do this by reinventing our activities to fit the modern world and by diversifying our leadership by age, gender, and geography.

We can hold maker fairs in addition to our traditional conferences. We can support entrepreneurs through crowdfunding of technology incubators. We can also offer a risk-free platform for our members to envision the future in wildly creative ways.

Our relevance will be virtually guaranteed if we provide an environment for each new generation of technologists to contribute to a positive future for all of society. ◆

RICK OLIVIER (2)

ISTOCKPHOTO

Guiding Technology Policy for the Internet

An IEEE initiative will focus on governance, cybersecurity, and privacy BY KATHY PRETZ

THE INTERNET HAS become a foundational component for conducting personal, company, and government business around the world, but it also presents challenges for policymakers on such issues as protecting the privacy and security of their citizens' digital data. With hacking incidents, breaches in data security, and invasions of privacy on the rise, many governments are working to strengthen their protection regulations.

The European Union, for example, is proposing rules that require data-protection safeguards to be built into new products. Some countries are considering implementing a "right to be forgotten" law, whereby outdated information about an individual must be removed by search engine companies. Others also want to change how apps and websites gather personal information. And all countries are struggling with how best to govern the Internet in their regions.

All these measures can be assisted by technology and can benefit from the involvement of representatives from high-tech companies. IEEE believes that technologists should be involved with shaping technology policy by providing sound guidance for legislators and policymakers so they can better understand the implications of their decisions. That's why the organization launched the IEEE Internet Initiative, a platform dedicated to bringing together the technical community with policymakers to discuss Internet governance, cybersecurity, and privacy.

"It's not uncommon for private individuals and companies to talk to legislators when legislation affects them," says IEEE Member Oleg Logvinov, chair of the initiative. "The initiative is not about IEEE becoming involved with policymaking. It's about providing a platform for legislators and policymakers from around the world, IEEE members, and the larger technical community to communicate with and educate each other.

IEEE is a neutral, global platform. We do not speak for a particular country or company

"Building on the work of IEEE-USA, which supports the career and public policy interests of U.S. members, this initiative is concerned with global Internet technology policymaking."

UNIQUE FORUM

IEEE is uniquely suited to be a credible forum that can help ensure trustworthy applications and best practices in Internet technology and related policymaking, according to the initiative's program director, IEEE staffer James Wendorf.

After all, IEEE members helped develop just about every aspect of the Internet, and they are at work building its future. Wendorf also points to the organization's well-regarded reputation for open collaboration and consensus building in its standards-development process, which brings together individuals and organizations with diverse technical and geographic points of view.

"IEEE is a neutral, global platform," Wendorf says. "We do not speak for one particular country or company."

And IEEE has been involved with security and privacy issues for more than 30 years. In 2014 it launched the IEEE Cybersecurity Initiative (http://cybersecurity.ieee.org) to accelerate innovative research and develop cybersecurity and privacy technologies.

GETTING INVOLVED

To help members and others understand the issues and get involved with informing and shaping policy, the IEEE Internet Initiative is hosting workshops around the world. The first IEEE Experts in Technology and Policy Forum on Internet Governance, Cybersecurity, and Privacy was held on 18 May in San Jose, Calif., in conjunction with the IEEE Symposium on Security and Privacy.

The forum brought together invited cybersecurity and privacy technologists and policy experts from Africa, Asia, the European Union, and the United States. The attendees developed a list of issues and challenges that will be posted on the initiative's website, http://internetinitiative.ieee.org, along with a white paper that covers the issues in more depth and outlines plans for addressing them. In the future, such workshops will be held in conjunction with other related events.

Members can also join the IEEE Internet Initiative Technology and Policy Community to get the latest news about the initiative.

But the workshops are not the only way IEEE can help, Wendorf notes.

"As technology experts develop their technologies and products, we can connect them to the policy people who, in turn, can inform them about the latest discussions on privacy and security regulations. If you really want technologies that benefit humanity, you must develop them while working with people who are setting the policies on how they will be regulated." ◆

OPINIONS

QUESTION OF THE MONTH

Should Patients Have Access to Their Electronic Medical Records?

After a Ph.D. mechanical engineering student "pushed and prodded" to collect an estimated 70 gigabytes of his own medical records, according to an article in *The New York Times,* he learned enough to alert doctors when his symptoms indicated a cancerous brain tumor, since removed. While many in the medical community believe this is an example of why patients should have full access to their electronic records, others are concerned that most patients aren't equipped with the skills to analyze the data properly, which could cause undue concern and unnecessary doctor visits.

CHIME IN *Tell us what you think by commenting online at http://theinstitute.ieee.org/opinions/question.*

Sparking Conversation

In March, we described IEEE's efforts through its Cybersecurity Initiative to help engineers defend systems. The issue also covered ways to better secure mobile devices and better educate cybersecurity professionals. The conversation continued on our website.

ASK THE EXPERTS

Greg Shannon, chair of the IEEE Cybersecurity Initiative; Michael Waidner, director of the Fraunhofer Institute for Secure Information Technology; and Anuja Sonalker, vice president of engineering and operations for TowerSec Automotive, answered readers' questions.

Q: ***How can we address security flaws before a system is even designed, rather than after the fact?***
Shannon: Long-term, we need to get people out of the loop of verifying the security and privacy properties of software, protocols, systems, networks, and so forth. People are too error-prone. Technologies are emerging to handle the tedious and detailed work of auditing code for correct implementation and configuration for security and privacy.

Q: ***What potential threats could cybersecurity administrators face?***
Waidner: People with authority for a system, such as IT administrators, are the prime targets of cyberattacks. They must be aware of the scope of social engineering attacks and risky practices, like reusing passwords across different services or using personal devices in a professional context. Organizations must limit the privileges of their administrators to what is needed in a specific context and should closely monitor an administrator's activities to detect misuse early on.

Q: ***How many years do you think it will be before the Internet will be secure?***
Sonalker: Honestly, never—unless we completely discard the current Internet and rebuild it knowing what we know today about its use and misuse. The Internet was built primarily for communicating, yet it has evolved into a medium of commerce, community, data storage, and so much more. Security was never a concern in the original design.

BECOMING A SECURITY PRO

We interviewed some experts who said that better training and credentials are needed to help meet the growing demand for cybersecurity specialists. One reader highlighted another challenge.

"There is a need to categorize the many disciplines inherent in cybersecurity. At the same time, educators must accept that this is a dynamic, ever-changing domain. For example, if a teacher takes a year or two to finalize a course syllabus, that course is outdated by the time of the class because of new technologies, trends, threats, and risks. The curriculum must constantly adapt. And unfortunately, no one has yet looked at including cybersecurity in primary- and secondary-level education."

CATASTROPHIC CYBERATTACK?

We asked readers whether they thought a widespread attack might occur in the next 10 years, as several experts predict. One reader wrote:

"Given that billions have already been stolen and harm has already come to more than one nation's security and capacity to defend itself, it is naive to believe the risk is overblown. The amazing thing is that the losses aren't already much higher. Fortunately, most attackers are not all that sophisticated, yet they manage to do a great deal of damage—and make plenty of money doing it."

FOR HIRE: ETHICAL HACKERS

We highlighted some organizations, including the FBI, that are hiring hackers to find security flaws in their systems. But one reader questioned the ethics behind this.

"Teaching employees to be hackers, not to be better programmers, is the same as saying that cheaters can win in the end and if you can't beat them, join them." ◆

ISTOCKPHOTO; BONNIE NANI

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E-Health: Our New Endless Frontier

DARREN CARROLL

IN 1945, Vannevar Bush provocatively titled a report to U.S. President Franklin Delano Roosevelt "Science, The Endless Frontier." Bush, director of the U.S. Office of Scientific Research and Development, wrote that the endless frontier that was science would be key to the nation's health, prosperity, and security in the modern world.

Bush was right.

In 1947, ENIAC, the first electronic general-purpose computer, made its debut. That year also saw the birth of the transistor, which transformed electronics. In 1948, IEEE Fellow Claude Shannon developed information theory and set the foundation for modern communications and computing technology.

And that was just the edge of Bush's endless frontier. The next 15 years would usher in the first solar photovoltaic cell; the launch of Sputnik 1, the first artificial satellite; the birth of the laser; and the first computer language compiler, among many other milestones.

Technological advances kept building one on another, bringing us to where we are now: in the midst of yet another revolutionary period in engineering. That revolution is e-health, the convergence of the broad scope of the life and health sciences with the all-encompassing realms of engineering.

While e-health is all that, it is also much more. It is a revolution in analytics, crunching the millions of data points created by sensors monitoring our vibrancy and well-being. It is a revolution in cybersecurity, as we try to ensure that medical data and medical devices are kept safe and secure. It is nanotech biosensors communicating molecular changes rather than electromagnetic signals.

It is also how best to craft responsible public policy for technology and to address the questions that arise with each advance [see p. 11]. And e-health offers a thousand more avenues for discovery along a truly endless frontier.

INDEPENDENT LIVING

It is difficult to point to a single topic in e-health that can unify great numbers of these disparate pursuits. Perhaps we can start with ambient assisted living. AAL gained popularity in 2008, when the European Union launched its first initiative to support it. The goal of AAL is to allow people to live longer, healthier lives in their own homes. From that seemingly simple concept has arisen a multitude of applications, monitoring devices, sensors, and innovations, like wearable technology.

In Japan, AAL has become particularly important. According to government surveys, the number of people age 65 and older now exceeds one-fourth of Japan's population. Meeting the needs of this burgeoning group will be critical in the immediate future.

Work on meeting those needs is already taking place across the breadth of IEEE's activities. Nearly half the January issue of *IEEE Communications Magazine* was devoted to AAL and the diverse topics that it intersects, including the Internet of Things, cloud computing, and green energy. An excellent series of articles showcased some of the best work currently being done in AAL.

Throughout this year, the global IEEE community will hold conferences, like HealthCom2015 and IEEE E-Health and Bioengineering, as well as other convocations where topics such as AAL and e-health will be examined in depth. In addition, work on informatics standards is addressing the personal information needs that are a part of an AAL environment.

MORE WORK AHEAD

For all that has been accomplished, much must still be done. Fortunately, many within the IEEE global community are focusing their efforts on technology that will benefit our oldest citizens, enabling them to live life on their terms, in an environment that values their independence while helping them maintain optimal health.

The unparalleled promise that e-health holds for our world is why we, as engineers, pursue our respective passions

The discussion of e-health, however, does not begin and end with AAL. In truth, it is difficult for me to even think where a discussion of e-health could "end." Today, we're seeing prosthetics and medical devices interfacing ever more seamlessly with the natural biology of the human body. We're making strides in using DNA as an effective, efficient means of data storage and retrieval. Those born deaf are now hearing for the first time; those with impaired sight can gaze upon their loved ones.

The unparalleled promise that e-health holds for our world is why we, as engineers, pursue our respective passions. In e-health, we have found another endless frontier, one that IEEE, as it has in the past, will explore in depth. I look forward to what we will find.

I know many of you are already doing exceptional work in e-health. Please write to president@ieee.org and tell me what you're exploring and accomplishing. ◆

KONSTANTINOS KARACHALIOS AND EILEEN M. LACH

IEEE's Policy for Patented Technologies Included in IEEE Standards

IEEE'S STANDARDS COME AS close to embodying IEEE's mission to advance technology for humanity as one can get. For more than a century, IEEE standards have protected us, connected us, and defined best engineering practices; they are renowned worldwide as pearls of technology.

Some of them, such as the IEEE 802.11 and the 802.3 families of standards (popularly known as Wi-Fi and Ethernet), are so ubiquitous and successful that they are perceived as global public goods. In particular, IEEE 802.11 has become synonymous with globally present connectedness and free Internet surfing through countless hot spots around the planet. One could say that people now feel at home wherever there is good Wi-Fi.

What looks so easy and free, however, is possible only through significant investment in technology development. Countless companies invest in both R&D and in the production of goods that embody our standards and touch upon all aspects of our lives. But investment in good technology alone is not enough.

The standards established under the rules of IEEE are bottom-up, voluntary, and market relevant. They are agreed on by open and global communities and by people from many countries and from otherwise fiercely competing companies. Those involved are not only the best technology experts but also skilled ambassadors and diplomats in their fields. Thus, IEEE has also become the home of many companies from all around the world—big and small, startups and powerful, well-established companies—that vie to contribute innovative technologies to our standards. In return, these companies receive substantial royalties for their patented technologies.

The inclusion of patented technologies, in particular in information and communications technology (ICT) interoperability standards, gives patent owners both the incentive and the means to steer technological development in certain directions. Without robust rules that help to create and maintain a level playing field for all participants, though, standardization ecosystems—even if they claim to be based on formally open processes—could rapidly deteriorate to become de facto closed or, at the very least, tightly controlled by a few powerful incumbents. Such an outcome would not only defy our mission statement but also undermine the future of IEEE's standards system.

Thus, it is vital that ***IEEE remain a neutral home***, giving equal opportunity for stakeholders in any technology space to work together openly in order to advance innovation.

PATENT POLICY UPDATE

A standards development organization's patent policy is at the core of the governance of its standardization process. The policy sets the balance between contributors and users of privately owned technologies and makes it possible to choose between different technological options early in the process.

Each organization has its own set of rules, all trying to address complex questions and dilemmas, with two issues emerging as the most contentious: (1) what constitutes reasonable terms of licensing, and (2) under what circumstances a patent owner can seek a prohibitive order, that is, a court order or governmental trade regulatory organization exclusion order that bars the sale or importation of a product that infringes a patent simply by implementing a standard.

The debate over these questions arose partly in response to high-profile court cases and to a series of statements of concern from antitrust and competition authorities from Europe, the United States, and, most recently, China. The discussions have been going on for several years in all the important standards-development groups in the ICT field, including the IEEE Standards Association, the standards developing body of IEEE. The debate has become highly polarized as standards developers, technology owners, and standards implementers weigh in.

This unfolded in a fast-evolving industry landscape with constantly shifting fronts and business interests—for instance, a strong technology owner in one standardization field may be mainly an implementer in another one.

As the decision-making process was advancing, IEEE members and the public became exposed to a flurry of articles, arguments, and even advertising campaigns from interested parties trying to convince the neutral IEEE governance structure of the strength of their positions.

At the end of a rigorous and transparent two-year process, with several independent approval phases and many opportunities for public comment, an update to the IEEE Standards Association patent policy has been approved. It was developed under the guidance of the Patent Committee of the IEEE-SA Standards Board and then endorsed by the Standards Board and the IEEE-SA Board of Governors, with supermajorities reaching up to 75 percent. Normally, the story would have ended there, as changes to the Standards Board Bylaws (to which the patent policy belongs) need to be ultimately approved by the IEEE-SA's Board of Governors.

However, in this case, IEEE made a unique exception. Given the formidable strategic and public policy dimensions of the matter, IEEE's Board of Directors engaged in an extensive review of the proposal and ultimately decided on its merits. The patent policy was approved during the February 2015 IEEE Board of Directors meeting.

CRITICAL ISSUES CLARIFIED

The approved policy improves clarity and transparency with respect to the two key questions mentioned above. It also clarifies several other critical issues in the IEEE Standards Association Standards Board Patent Policy, that is, nondiscrimination between license seekers and reciprocity in licensing negotiations. In addition, a favorable Business Review Letter was issued by the U.S. Department of Justice in which the DOJ stated that it "has no present intention to take antitrust enforcement action against the conduct" described in the IEEE-SA Patent Policy update.

Further, the DOJ "concludes that the Update has the potential to benefit competition and consumers by facilitating licensing negotiations, mitigating holdup and royalty stacking, and promoting competition among technologies for inclusion in standards."

IEEE was able to conclude this exercise because of its unique nature, structure, and governance system, based on the ethos of the fiduciary duty of its volunteers. By enhancing clarity and transparency around virtually all key issues identified by regulatory authorities, IEEE-SA is aiming to make the rules of engagement more predictable for all players involved. The objective is for IEEE standards to continue to be broadly adopted and implemented worldwide, in accordance with IEEE's aspiration to generate and disseminate technical knowledge as a global public good. ◆

ISTOCKPHOTO

Karachalios is the managing director of the IEEE Standards Association. Lach is IEEE's general counsel and chief compliance officer.

A version of this article previously appeared online.

BENEFITS

Conferences on Technologies for Better Health

Upcoming IEEE events cover wearables, biosensors, and e-health

ISTOCKPHOTO

IEEE Rock Stars of Wearables

AUSTIN, TEXAS; 23 SEPTEMBER

TOPICS: Smart watches, smart textiles, health data analysis, untethering wearable devices from smartphone apps, software design for wearables, wearables and fashion, sleep monitors, body sensors, and cloud computing.

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IEEE International Conference on Application of Information and Communication Technologies

ROSTOV-ON-DON, RUSSIA; 14–16 OCTOBER

TOPICS: Mobile health technologies, e-health and telemedicine, health care management systems, human-machine interfaces for people with disabilities, medical informatics, decision support systems, augmented reality, and data mining.
SPONSOR: IEEE Computer Society
VISIT: http://aict.info/2015

International Symposium on Bioelectronics and Bioinformatics

BEIJING; 14–17 OCTOBER

TOPICS: Wearable devices, biosensors, biometrics, biomedical signal and image processing, computer-aided diagnostics, health care information systems, clinical decision support systems, biomechanics, prosthetics, and brain-computer interfaces.
SPONSOR: IEEE Engineering in Medicine and Biology Society
VISIT: http://www.isbb2015.org.cn

IEEE International Conference on E-Health, Networking, Application, and Services

BOSTON; 14–17 OCTOBER

TOPICS: Medical device interoperability, wearables, smart textiles, energy harvesting, biosensors, electronic medical records, medical imaging, big data, antennas and propagation, software-defined networks, human-computer interaction, and robotics for e-health.
SPONSOR: IEEE Communications Society
VISIT: http://www.ieee-healthcom.org

International Conference on Innovations in Information Technology

DUBAI; 1–3 NOVEMBER

TOPICS: Wearable devices, e-health, big data, cybersecurity, the smart grid, mobile networks, mobile computing, cloud computing, the Internet of Things, smart appliances, risk management, decision-support systems, high-performance computing, and energy efficiency.
SPONSOR: IEEE Computer Society
VISIT: http://www.it-innovations.ae/iit2015/index.html

IEEE Components, Packaging, and Manufacturing Technology Symposium

KYOTO; 9–11 NOVEMBER

TOPICS: Packaging technologies for wearable devices, biosensors, optoelectronics, and RF components; thermal management; signal and power integrity; reliability and failure mechanisms; packaging materials; and photonics.
SPONSOR: IEEE Components, Packaging, and Manufacturing Technology Society
VISIT: http://www.ieee-csj.org ◆

Keeping Up With Advances in Health Technology

BY AMANDA DAVIS

DEVICES SUCH AS WEARABLE fitness trackers, smart textiles, and biosensors connected to smartphone apps are making it easier for doctors to take care of their patients and for people to take care of themselves. IEEE offers several ways to get up to speed on the latest in health technology.

WEB PORTAL

The IEEE Life Sciences Initiative's Web portal (http://lifesciences.ieee.org) contains a wealth of information on related standards, publications, career and education programs, and upcoming conferences. Join the IEEE Life Sciences Community to receive a monthly e-newsletter with the latest news and announcements from the initiative.

VIDEOS

The Life Sciences portal also offers videos featuring technologies designed to monitor disease and help doctors diagnose patients in remote areas, as well as assist people with disabilities.

In "Saving Lives, One Phone at a Time," Kuldeep Singh Rajput, a Ph.D. student at the National University of Singapore, demonstrates a wearable electrocardiogram monitor he designed to diagnose the growing number of people with heart disease in India.

In another video, IEEE Member Conor Walsh and a team of researchers from the Wyss Institute at Harvard discuss the Soft Exosuit. Meant to be worn under clothing, the suit can help stabilize and propel the leg muscles so that people with physical disabilities can walk with less effort.

PUBLICATIONS

The *IEEE Journal of Biomedical and Health Informatics*, published bimonthly by the IEEE Engineering in Medicine and Biology Society (EMBS), features the latest research in a number of areas, including wearable medical devices, biomedical data acquisition and processing, diagnostic tools, electronic medical records, and body sensor networks.

EMBS also sponsors *IEEE Pulse*, a bimonthly magazine that focuses on biomedical technologies and methods, clinical engineering, the social implications of medical technologies, and more. Readers following the wearables trend may be interested in "Weaving Innovation: Technical Textile Applications in Healthcare," the September/October 2014 cover story on smart textiles for health monitoring and wound care. Also of interest is "Biosensors in Diabetes," in the May/June 2014 issue, which describes a proposed biosensor that, when implanted in contact lenses, could measure glucose levels in a person's tears. The sensor can then inform its wearer when to take insulin and at what dose.

The IEEE Consumer Electronics Society also offers publications that touch on health technology. For example, in July 2014 *IEEE Consumer Electronics Magazine* published "How Wearables Intersect With the Cloud and the Internet of Things," which delves into the technologies, usage patterns, and business models of wearable devices.

Look for these publications and others in the IEEE Xplore Digital Library. ◆

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Joel Rodrigues: Accelerating E-Health Applications

Helping people live healthier and longer

BY **PRACHI PATEL**

DIGITAL INNOVATIONS HAVE transformed health care in numerous ways. People today use smartphone apps to monitor their health and chat online with physicians. In the future, sensors on our bodies, in our clothes, and inside the objects around us could keep track of almost our every move, relaying information to computer systems that can inform medical professionals when something is wrong.

IEEE Senior Member Joel Rodrigues is developing the networking technologies that will make these electronic health, or e-health, applications possible. As a professor of informatics, Rodrigues leads the Next-Generation Networks and Applications group at the University of Beira Interior, in Covilhã, Portugal. There he is focused on wireless and body sensor networks, mobile and cloud computing, and information management. He is also a senior researcher at the Institute for Telecommunications, a national research laboratory, and is cofounder and chair of the IEEE Communications Society's E-Health Technical Committee.

Most recently, he was part of a national consortium of researchers from academia and industry, led by Microsoft Portugal, that developed assistive technologies to help the elderly live independently. He also coauthored the book *Ambient Assisted Living*, coming out this month.

As an engineer, Rodrigues says he "works hard to further state-of-the-art technologies that help shape our world and create a better future for coming generations."

THE E-HEALTH UMBRELLA

E-health, Rodrigues explains, is simply an umbrella term covering technologies that contribute to health. These include electronic health records; telemonitoring devices, which track patients' conditions remotely; and mobile health apps and wearables.

Rodrigues has a special interest in wireless body area networks, which are embedded in clothes and even implanted under the skin. There they can continuously monitor such vital signs as blood pressure, glucose levels, body temperature, and respiratory rate. These sensors must communicate wirelessly with one another and with central computer systems quickly and securely, using minimal energy and bandwidth. Rodrigues is working on new kinds of architectures and communication protocols for these body sensor networks as well as mobile health applications.

His expertise was put to good use in the assisted living project. Among other things, the researchers developed sensors for checking air quality, voice-recognition systems to help users operate electronics, and motion-sensing systems that monitor people's movements to ensure they are safe. Rodrigues helped develop algorithms and computation techniques to wirelessly transmit the tremendous amount of data these sensors generate and then collect and analyze it all. He also developed a mobile app that can alert emergency services if a user falls.

Because aspects of e-health raise privacy concerns, he is also working on data encryption algorithms. While conceding that privacy is a valid concern, Rodrigues believes the benefits outweigh the risks. "Patients can easily access all their medical information online," he says, "and so can their physicians."

A BUSY VOLUNTEER

As a computer science and engineering student at the University of Coimbra, in Portugal, Rodrigues became friends with several medical school students, which led him to thinking about how technology could aid medicine.

Graduating in 1995, Rodrigues became a network and system administrator at the university's hospital. He soon moved to Covilhã, about 140 kilometers east, to head the computer science and information department at the University of Beira Interior's new hospital. In 2002 he joined IEEE as a graduate student member—the same year he began pursuing a Ph.D. in informatics engineering at the university, which he completed in 2006.

Rodrigues became secretary of the IEEE Computer Society's Communications Software Technical Committee in 2008 before becoming its chair. He then helped found the E-Health Technical Committee in 2009. As its chair, one of his responsibilities is to bolster the committee's conferences and events. To this end, he is involved in IEEE HealthCom and chairs its steering committee. This year's conference will cover topics such as body and wearable sensor systems, e-health security and privacy, and mobile telemedicine.

Rodrigues also organized and chaired the first International Workshop on Medical Applications Networking, where he launched an e-health track. He edited the IEEE Communications Society's Best Readings in E-Health—a Web page that features books, journals, articles, and papers on the topic.

IEEE members can play key roles in developing e-health applications, standards, and security

For Rodrigues, IEEE holds a unique position in the growth of e-health. It brings together technology experts of all stripes, including those involved in sensor networks, biomedicine, communications, and computing. His goal is to leverage this expertise by getting everyone to work together to take e-health to the next level—and the next level after that.

"We have excellent, world-renowned researchers on every technical topic under the IEEE umbrella," he says. "Members can play key roles, not just in developing e-health applications but also in the areas of standards, security, and privacy, and in promoting their adoption around the globe."

Being a leader in IEEE helps him broaden his reach, points out Rodrigues. "It is the best way to be involved in the engineering community and have an impact." ◆

UNIVERSITY OF BEIRA INTERIOR

Part-time Passions

Norm Swanberg

Jazz Aficionado

NORM SWANBERG was an ardent rock 'n' roll fan when he went to the Newport Jazz Festival in Rhode Island in 1970 to see a jazz-rock band perform. Swanberg [below], then a junior studying physics at nearby Brown University, in Providence, was hooked.

Jazz quickly became his music of choice. He now channels his love for it as the host of a weekly radio show on KSDS-FM, San Diego's award-winning jazz station. "The beauty of jazz is in its diversity and the variety among different artists and eras," he says.

On his two-hour evening show, Swanberg, now an IEEE senior member, mixes music with historical tidbits and interviews with jazz personalities. By day, he designs radio-frequency systems for commercial and military clients through his consulting business, Dome Resonators, in Poway, Calif.

The radio gig began in 1990 when, as a recent transplant to San Diego, he found himself sitting next to a KSDS disc jockey at a jazz piano concert. "It was a happy accident," he says. "I told him how much I loved his station and wanted to come there and volunteer, and eventually even work there." The disc jockey advised Swanberg to take radio production classes at the city college, which he did before becoming a radio host.

The methodical nature that aids Swanberg's engineering work also benefits his radio gig. For each show, he creates a spreadsheet on which he lists each song along with its length, the artist's name, and the albums. He then calculates the timing of each segment so that he can break at the right moment for one of the station's public service announcements.

He spends about two hours preparing for every show. If he is interviewing an artist, he reads about the person, listens to his or her albums, and prepares questions. In his 25 years as a radio host, Swanberg has met and interviewed many famous jazz musicians, including Dave Brubeck, Diana Krall, and Herbie Hancock.

Working from home for his own company also lets Swanberg sneak in his passion during work hours. "When I'm sitting at my desk doing circuit simulations, I always have jazz in the background," he says. "If something catches my attention, I put it in my spreadsheet."

He owns a saxophone but hasn't had time to play it for more than 20 years. He hopes to change that as retirement inches closer. "These days I play the radio dial," Swanberg says, chuckling, "but someday I'll play an instrument again."

—Prachi Patel

Ray Ballisti

Staying Zen

THIRTY-SEVEN YEARS ago, IEEE Life Member Ray Ballisti decided to try martial arts as a way to relieve stress from work. He first trained in kendo, the Japanese art of sword combat, but later switched to iaido. This austere, noncombative art, involving precise and fluid movement with a samurai sword, gave Ballisti the perfect blend of introspection and physicality.

Iaido (pronounced ee-ah-ee-do), which is sometimes called "moving Zen," is performed solo against imaginary opponents, although people sometimes practice with others. It is primarily a mental sport and requires extreme control and focus. Practitioners wear traditional clothing and learn techniques for smoothly drawing a sword from its sheath, striking opponents, and resheathing the sword. Wooden, blunt, or sharp swords are used, each of which requires different skills. Instead of sparring with others, practitioners are tested on the form of their swordsmanship in side-by-side duels in front of referees.

Ballisti [above], who is retired, was working as a computer systems manager at the Swiss Federal Institute of Technology, in Zurich, when he discovered the sport. He managed four Unix servers used by 60 researchers, which he found stressful.

Now 71, he holds the fifth rank, or *dan*, in iaido. The ranking is based on skill. Eight is the highest rank. He also teaches a two-hour class twice a week at the same martial arts studio in Zurich where he started as a student.

Iaido has helped Ballisti build his problem-solving skills by teaching him to expect the unexpected. "If you were to have an opponent, you cannot expect that he or she will behave as you do, so you must be open to all possibilities," he says. Students learn to follow specific procedures, but over time they can change technique to demonstrate countermovement, or *kata*, to showcase their range and their ability to defend against potential opponents. "This is the way to approach a problem: Do not discard any possibilities, but take them all into account."

The sport taught him to be patient, modest, accepting of criticism and, above all, to believe in himself. All of this helped him become a better engineer and team player at work.

Through his practice, he also gained the ability to empty his mind of distractions, focus on his thoughts and actions, make swift decisions, and then execute them well, which he says helped make him an effective computer systems manager.

Ballisti recalls how he would often get several requests at once to resolve technical issues from colleagues "who wanted their problem solved before others," he says. "But I did not let myself get distracted. I moved ahead one problem at a time." *—P.P.*

TOP: RAY BALLISTI; BOTTOM: NORM SWANBERG

OF NOTE

Nominations Needed: Technical Field Awards

Submit your nominations by 31 January 2016

IEEE Biomedical Engineering Award
For outstanding contributions to the field of biomedical engineering.
SPONSORS: IEEE Engineering in Medicine and Biology, IEEE Circuits and Systems, and IEEE Computational Intelligence societies

IEEE Cledo Brunetti Award
For outstanding contributions to nanotechnology and miniaturization in the electronic arts.
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IEEE Components, Packaging, and Manufacturing Technology Award
For meritorious contributions to the advancement of components, electronic packaging, or manufacturing technologies.
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IEEE Control Systems Award
For outstanding contributions to control systems engineering, science, or technology.
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IEEE Electromagnetics Award
For outstanding contributions to electromagnetics in theory, application, or education.
SPONSORS: IEEE Antennas and Propagation, IEEE Electromagnetic Compatibility, IEEE Geoscience and Remote Sensing, and IEEE Microwave Theory and Techniques societies

IEEE James L. Flanagan Speech and Audio Processing Award
For an outstanding contribution to the advancement of speech and/or audio signal processing.
SPONSOR: IEEE Signal Processing Society

IEEE Fourier Award for Signal Processing
For an outstanding contribution to the advancement of signal processing, other than in the areas of speech and audio processing.
SPONSORS: IEEE Circuits and Systems and IEEE Signal Processing societies

IEEE Andrew S. Grove Award
For outstanding contributions to solid-state devices and technology.
SPONSOR: IEEE Electron Devices Society

IEEE Herman Halperin Electric Transmission and Distribution Award
For outstanding contributions to electric transmission and distribution.
SPONSORS: Robert and Ruth Halperin Foundation, in memory of Herman and Edna Halperin, and the IEEE Power & Energy Society

IEEE Masaru Ibuka Consumer Electronics Award
For outstanding contributions in the field of consumer electronics technology.
SPONSOR: Sony Corp.

IEEE Internet Award
For exceptional contributions to the advancement of Internet technology for network architecture, mobility, and/or end-use applications.
SPONSOR: Nokia Corp.

IEEE Richard Harold Kaufmann Award
For outstanding contributions in industrial systems engineering.
SPONSOR: IEEE Industry Applications Society

IEEE Joseph F. Keithley Award in Instrumentation and Measurement
For outstanding contributions in electrical measurements.
SPONSORS: Keithley Instruments and IEEE Instrumentation and Measurement Society

IEEE Gustav Robert Kirchhoff Award
For an outstanding contribution to the fundamentals of any aspect of electronic circuits and systems that has a long-term significance or impact.
SPONSOR: IEEE Circuits and Systems Society

IEEE Koji Kobayashi Computers and Communications Award
For outstanding contributions to the integration of computers and communications.
SPONSOR: NEC Corp.

IEEE William E. Newell Power Electronics Award
For outstanding contribution(s) to the advancement of power electronics.
SPONSOR: IEEE Power Electronics Society

IEEE Daniel E. Noble Award for Emerging Technologies
For outstanding contributions to emerging technologies recognized within recent years.
SPONSOR: Motorola Solutions Foundation

IEEE Donald O. Pederson Award in Solid-State Circuits
For outstanding contributions to solid-state circuits.
SPONSOR: IEEE Solid-State Circuits Society

IEEE Frederik Philips Award
For outstanding accomplishments in the management of research and development resulting in effective innovation in the electrical and electronics industry.
SPONSOR: Philips Electronics NV

IEEE Photonics Award
For outstanding achievements in photonics.
SPONSOR: IEEE Photonics Society

IEEE Robotics and Automation Award
For contributions in the field of robotics and automation.
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IEEE Frank Rosenblatt Award
For outstanding contribution(s) to the advancement of the design, practice, techniques, or theory in biologically and linguistically motivated computational paradigms, including but not limited to neural networks, connectionist systems, evolutionary computation, fuzzy systems, and hybrid intelligent systems in which these paradigms are contained.
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IEEE Marie Sklodowska-Curie Award
For outstanding contributions to the field of nuclear and plasma sciences and engineering.
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IEEE Innovation in Societal Infrastructure Award
For significant technological achievements and contributions to the establishment, development, and proliferation of innovative societal infrastructure systems through the application of information technology with an emphasis on distributed computing systems.
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IEEE Charles Proteus Steinmetz Award
For exceptional contributions to the development and/or advancement of standards in electrical and electronics engineering.
SPONSOR: IEEE Standards Association

IEEE Eric E. Sumner Award
For outstanding contributions to communications technology.
SPONSOR: Bell Labs, Alcatel-Lucent

IEEE Nikola Tesla Award
For outstanding contributions to the generation and utilization of electric power.
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IEEE Kiyo Tomiyasu Award
For outstanding early to mid-career contributions to technologies holding the promise of innovative applications.
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IEEE Transportation Technologies Award
For advances in technologies within the fields of interest to the IEEE as applied in transportation systems.
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TEACHING AWARDS

IEEE Leon K. Kirchmayer Graduate Teaching Award
For inspirational teaching of graduate students in the IEEE fields of interest.
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IEEE Undergraduate Teaching Award
For inspirational teaching of undergraduate students in the fields of interest of IEEE.
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