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Tech e Bytes

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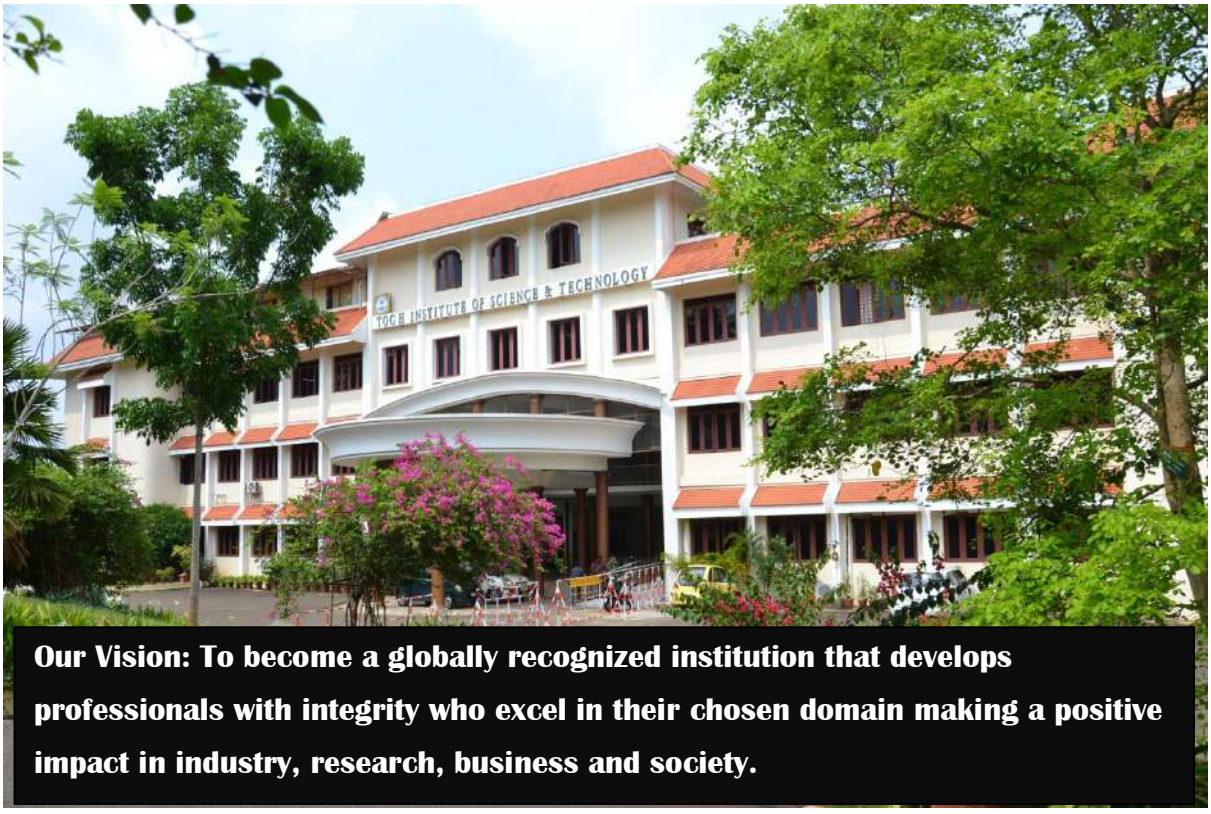
"WE DON'T DO DIFFERENT THINGS, WE DO THINGS DIFFERENTLY"



Our Vision: To become a globally recognized institution that develops professionals with integrity who excel in their chosen domain making a positive impact in industry, research, business and society.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

VISION OF CSE DEPARTMENT

To acquire global excellence in the field of Computer Science and Engineering, nurturing in professionals, technical competence, innovative skills, professional ethics and social commitment.

MISSION OF CSE DEPARTMENT

- To equip students with a strong foundation in the area of Computer Science and Engineering using effective teaching -learning practices.
- To provide state-of-the-art infrastructure to suit academic, industry and research needs at the global level.
- To engage students and faculty in interdisciplinary research that promotes innovative ideas for sustainable development.
- To incorporate skill enhancement programmes for students and faculty to cope with the contemporary developments in technology.
- To inculcate effective communication skills, professional ethics and social commitment among professionals through value added programs.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Computer Science & Engineering will

1. Evolve as globally competent computer professionals, researchers and entrepreneurs possessing collaborative and leadership skills, for developing innovative solutions in multidisciplinary domains.
2. Excel as socially committed computer engineers having mutual respect, effective communication skills, high ethical values and empathy for the needs of society.
3. Involve in lifelong learning to foster the sustainable development in the emerging areas of technology.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Student of the Computer Science and Engineering program will:

- **PSO1**: **Professional Skills:** Attain the ability to design and develop hardware and software based systems, evaluate and recognize potential risks and provide creative solutions.
- **PSO2**: **Successful Career and Entrepreneurship:** Gain knowledge in diverse areas of Computer Science and experience an environment conducive in cultivating skills for successful career, entrepreneurship and higher studies.

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Meet the personality

James Gosling, (born May 19, 1955) is a Canadian computer scientist, best known as the founder and lead designer behind the Java programming language. Gosling initially became known as the author of Gosling Emacs. He also invented an early Unix windowing system called NeWS, which became a lesser-used alternative to the still used X Window, because Sun did not give it an open source license.

CONTENTS

Looking for errors in a 'black box'

THOMAS BIJU | S7 CSE

How do you find errors in a system that exists in a black box?

That is one of the challenges behind perfecting deep learning systems like self-driving cars. Deep learning systems are based on artificial neural networks that are modeled after the human brain, with neurons connected together in layers like a web. This web-like neural structure enables machines to process data with a non-linear approach -- essentially teaching itself to analyze information through what is known as training data.

When an input is presented to the system after being "trained" -- like an image of a typical two-lane highway presented to a self-driving car platform -- the system recognizes it by running an analysis through its complex logic system. This process largely occurs in a black box and is not fully understood by anyone, including a system's creators.

Any errors also occur in a black box, making it difficult to identify them and fix them. This opacity presents a particular challenge to identifying corner case behaviours. A corner case is an incident that occurs outside normal operating parameters. A corner case example: a self-driving car system might be programmed to recognize the curve in a two-lane highway in most instances. However, if the lighting is lower or brighter than normal, the system may not recognize it and an error could occur.

Shining a light into the black box of deep learning systems is what Yinzhi Cao of Lehigh University and Junfeng Yang and Suman Jana of Columbia University -- along with the Columbia Ph.D. student Kexin Pei -- have achieved with DeepXplore, the first automated white-box testing of such systems. Evaluating DeepXplore on real-world datasets, the researchers were able to expose thousands of unique incorrect corner-case behaviors. They will present their findings at the 2017 biennial ACM Symposium on Operating Systems Principles (SOSP) conference in Shanghai, China on October 29th in Session I: Bug Hunting.

"Our DeepXplore work proposes the first test coverage metric called 'neuron coverage' to empirically understand if a test input set has provided bad versus good coverage of the decision logic and behaviors of a deep neural network," says Cao, assistant professor of computer science and engineering.

In addition to introducing neuron coverage as a metric, the researchers demonstrate how a technique for detecting logic bugs in more traditional systems -- called differential testing -- can be applied to deep learning systems.

"DeepXplore solves another difficult challenge of requiring many manually labeled test inputs. It does so by cross-checking multiple DNNs and cleverly searching for inputs that lead to inconsistent results from the deep neural networks," says Yang, associate professor of computer science. "For instance, given an image captured by a self-driving car camera, if two networks think that the car should turn left and the third thinks that the car should turn right, then a corner-case is likely in the third deep neural network. There is no need for manual labeling to detect this inconsistency."

The team evaluated DeepXplore on real-world datasets including Udacity self-driving car challenge data, image data from ImageNet and MNIST, Android malware data from Drebin, and PDF malware data from Contagio/VirusTotal, and production quality deep neural networks trained on these datasets, such as these ranked top in Udacity self-driving car challenge.

Their results show that DeepXplore found thousands of incorrect corner case behaviors (e.g., self-driving cars crashing into guard rails) in 15 state-of-the-art deep learning models with a total of 132, 057 neurons trained on five popular datasets containing around 162 GB of data.

The team has made their open-source software public for other researchers to use, and launched a website, DeepXplore (www.deepxplore.org), to let people upload their own data to see how the testing process works.

"We found that for most of the deep learning systems we tested, even a single randomly picked test input was able to achieve 100% code coverage -- however, the neuron coverage was less than 10%," adds Jana, assistant professor of computer science.

The inputs generated by DeepXplore achieved 34.4% and 33.2% higher neuron coverage on average than the same number of randomly picked inputs and adversarial inputs (inputs to machine learning models that an attacker has intentionally designed to cause the model to make a mistake) respectively.

Reference: Lehigh University

Facial recognition software helps diagnose rare genetic disease

ANTONY VARGHESE| S7 CSE

Researchers with the National Human Genome Research Institute (NHGRI), part of the National Institutes of Health, and their collaborators, have successfully used facial recognition software to diagnose a rare, genetic disease in Africans, Asians and Latin Americans. The disease, 22q11.2 deletion syndrome, also known as DiGeorge syndrome and velocardiofacial syndrome, affects from 1 in 3,000 to 1 in 6,000 children. Because the disease results in multiple defects throughout the body, including cleft palate, heart defects, a characteristic facial appearance and learning problems, healthcare providers often can't pinpoint the disease, especially in diverse populations.

The goal of the study, published March 23, 2017, in the *American Journal of Medical Genetics*, is to help healthcare providers better recognize and diagnose DiGeorge syndrome, deliver critical, early interventions and provide better medical care.

The researchers studied the clinical information of 106 participants and photographs of 101 participants with the disease from 11 countries in Africa, Asia and Latin America. The appearance of someone with the disease varied widely across the groups.

Using facial analysis technology, the researchers compared a group of 156 Caucasians, Africans, Asians and Latin Americans with the disease to people without the disease. Based on 126 individual facial features, researchers made correct diagnoses for all ethnic groups 96.6 percent of the time.

Marius George Linguraru, D.Phil., M.A., M.B., an investigator at the Sheikh Zayed Institute for Pediatric Surgical Innovation at Children's National Health System in Washington, D.C., developed the digital facial analysis technology used in the study. Researchers hope to further develop the technology -- similar to that used in airports and on Facebook -- so that healthcare providers can one day take a cell phone picture of their patient, have it analyzed and receive a diagnosis.

This technology was also very accurate in diagnosing Down syndrome, according to a study published in December 2016. The same team of researchers will next study Noonan syndrome and Williams syndrome, both of which are rare but seen by many clinicians.

DiGeorge syndrome and Down syndrome are now part of the Atlas of Human Malformations in Diverse Populations launched by NHGRI and its collaborators in September 2016. When completed, the atlas will consist of photos of physical traits of people with many different inherited diseases around the world, including Asia, the Indian subcontinent, the Middle East, South America and sub-Saharan Africa. In addition to the photos, the atlas will include written descriptions of affected people and will be searchable by phenotype (a person's traits), syndrome, continental region of residence and genomic and molecular diagnosis. Previously, the only available diagnostic atlas featured photos of patients with northern European ancestry, which often does not represent the characteristics of these diseases in patients from other parts of the world.

Reference: NIH/National Human Genome Research Institute

HADES creates alternate reality to mislead hackers

ALEN JOY | S7 CSE

The Russian novelist Fyodor Dostoevsky once postulated that the devil no longer employs fire and brimstone but instead simply tells you what you want to hear.

Sandia National Laboratories cyber researchers go with that second option when it comes to foiling a hacker. Rather than simply blocking a discovered intruder, Vince Urias, Will Stout and Caleb Loverro deploy a recently patented alternative reality, dubbed HADES for High-fidelity Adaptive Deception & Emulation System, which feeds a hacker not what he needs to know but what he wants to believe.

"Deception is the future of cyber defense," said Urias. "Simply kicking a hacker out is next to useless. The hacker has asymmetry on his side; we have to guard a hundred possible entry points and a hacker only needs to penetrate one to get in."

Rather than being summarily removed from a data source, a discovered hacker is led unobtrusively into HADES, where cloned virtual hard drives, memory and data sets create a

simulation very much like the reality. However, certain artifacts have been deliberately, but not obviously, altered.

"So, a hacker may report to his handler that he or she has cracked our system and will be sending back reports on what we're doing," Urias said. "Let's say they spent 12 months gathering info. When they realize we've altered their reality, they have to wonder at what point did their target start using deception, at what point should they not trust the data? They may have received a year or so of false information before realizing something is wrong. A hacker informing his boss that he's discovered a problem doesn't do his reputation much good, he's discredited. And then the adversary must check all data obtained from us because they don't know when we started falsifying."

Furthermore, when a hacker finally puzzles out something is wrong, he must display his toolkit as he tries to discern truth from fiction.

"Then he's like a goldfish fluttering in a bowl," said Urias. "He exposes his techniques and we see everything he does."

"It used to be that technologically we couldn't move a visitor to a different reality without them knowing," said Urias, "but there's been a radical change in networking in the last 10 to 15 years, from hardware to software. With the ephemerality of the network fabric, I can change realities without a hacker knowing."

Adversaries want data that helps their situational awareness. "But when we change data in our fake world, we devalue information and set up eventual inconsistencies."

To do this, Urias said, "we move to another location in the cloud and build a slightly different world around them. Our intent is to introduce doubt. If they get something, is it real or is it fake? The worst horror for an adversary is the identical world, but changed. Can we introduce more work for them?"

HADES just won a 2017 R&D100 award, presented by *R&D Magazine* to recognize exceptional innovations in science and technology over the past year. The Sandia work, patented in October, began five years ago with a three-year Laboratory Directed Research and Development grant.

HADES can operate in multiple modes from a small organization without resources to a large company, he said. The Department of Homeland Security's Cyber Security Division has worked with Sandia on deployment.

Like any technique, HADES has its limitations. While the simplest deceptive environment can be done on a small private computer, environments of greater fidelity require more CPU and memory resources and may thereby reduce the number of virtual environments deployable on a single server.

What the information technology and cybersecurity communities want, Urias said, is what he wants: "To stop the [information] bleeding, and get actionable intelligence: What is an adversary looking for, what did they actually get, and how did they get it?"

The technique has allowed the researchers to locate malware an adversary has placed in a system, and is capable of active attack.

Reference: Sandia National Laboratories

First step toward practical application of holographic memory with magnetic assist

AYSHA ZENAB KENZA | S7 CSE

In recent years, due to technology such as the Internet and 8K broadcasting, more and more information has been distributed across the world. Along this trend, there is a demand for an innovative storage method for storing large volumes of data at ultra-high recording density and at ultra-high speed. Magnetic-holographic memory meets this demand. This new technology enables more than 1 TB worth of data (equivalent to the total capacity of 40 Blu-ray discs, each with a typical capacity of 25 GB) to be recorded in a disc the size of a DVD or Blu-ray disc.

In magnetic hologram recording, a medium is magnetized in one direction; then the medium is irradiated with an information-bearing beam (signal beam) and a reference beam; and the resulting interference pattern is recorded in the form of the difference in magnetization directions. When this recording proceeds with an external magnetic field applied to it, the recording of the difference in magnetization directions becomes clearer. The latter process is called magnetic assist recording.

The research group led by Yuichi Nakamura, Associate professor at Toyohashi University of Technology, has applied this magnetic assist recording technology to magnetic-holographic memory and, for the first time in the world, succeeded in reducing recording energy consumption and achieving non-error data reconstruction.

Through simulation, the group investigated the size of the stray magnetic field required for magnetization reversal in magnetic hologram recording. As a result, they found that the thinner the medium, the smaller the necessary stray magnetic field and the less clear the hologram recording. They also proved through experiments that magnetic assist recording yields a clear magnetic hologram even with a thin medium, and the magnetic hologram yields a bright reconstruction beam upon irradiation with a reference beam. Through further experiments, they found that magnetic assist recording and reconstruction of two-dimensional data yields clear reconstruction images. As a result of this research, the group have enabled for the first time in the world a significant reduction in errors in data recording and reconstruction with a small amount of energy as well as non-error recording and reconstruction with magnetic-holographic memory.

They intend to proceed with their work to improve recording density, and their goal is to apply this technology to make a portable, ultra-high-density, high-speed optical information storage medium (outperforming Blu-ray discs) capable of storing high-volume contents from various sources including 8K Super Hi-Vision broadcasting and 3D films; and to enable wide application of this technology in various types of storage systems, including archive and cold storage for storing information such as medical image data, SNS data on the Internet, and high-volume data in data centers.

Reference: Toyohashi University of Technology

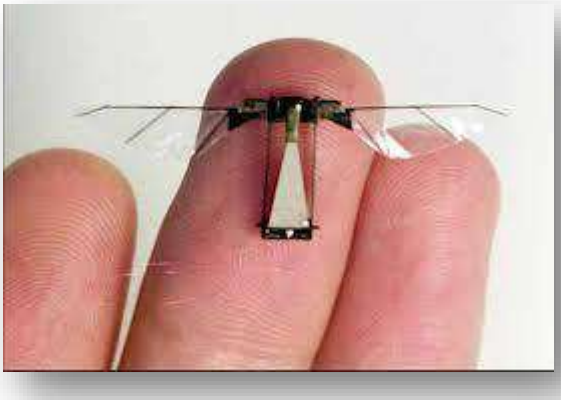
Engineers program tiny robots to move, think like insects

MELVIN MARTIN | S7 CSE

While engineers have had success building tiny, insect-like robots, programming them to behave autonomously like real insects continues to present technical challenges. A group of Cornell engineers has been experimenting with a new type of programming that mimics the way an insect's brain works, which could soon have people wondering if that fly on the wall is actually a fly.

The amount of computer processing power needed for a robot to sense a gust of wind, using tiny hair-like metal probes imbedded on its wings, adjust its flight accordingly, and plan its path as it attempts to land on a swaying flower would require it to carry a desktop-size computer on its back. Silvia Ferrari, professor of mechanical and aerospace engineering and

director of the Laboratory for Intelligent Systems and Controls, sees the emergence of neuromorphic computer chips as a way to shrink a robot's payload.



Unlike traditional chips that process combinations of os and 1s as binary code, neuromorphic chips process spikes of electrical current that fire in complex combinations, similar to how neurons fire inside a brain. Ferrari's lab is developing a new class of "event-based" sensing and control algorithms that mimic neural activity and can be implemented on neuromorphic chips. Because the chips require significantly less power than traditional processors, they allow engineers to pack more computation into the same payload.

Ferrari's lab has teamed up with the Harvard Microrobotics Laboratory, which has developed an 80-milligram flying RoboBee outfitted with a number of vision, optical flow and motion sensors. While the robot currently remains tethered to a power source, Harvard researchers are working on eliminating the restraint with the development of new power sources. The Cornell algorithms will help make RoboBee more autonomous and adaptable to complex environments without significantly increasing its weight.

To speed up development of the event-based algorithms, a virtual simulator was created by Taylor Clawson, a doctoral student in Ferrari's lab. The physics-based simulator models the RoboBee and the instantaneous aerodynamic forces it faces during each wing stroke. As a result, the model can accurately predict RoboBee's motions during flights through complex environments.

"The simulation is used both in testing the algorithms and in designing them," said Clawson, who helped has successfully developed an autonomous flight controller for the robot using biologically inspired programming that functions as a neural network. "This network is capable of learning in real time to account for irregularities in the robot introduced during manufacturing, which make the robot significantly more challenging to control."

Aside from greater autonomy and resiliency, Ferrari said her lab plans to help outfit RoboBee with new micro devices such as a camera, expanded antennae for tactile feedback, contact sensors on the robot's feet and airflow sensors that look like tiny hairs.

Reference: Cornell University

Secure payment without leaving a trace

MANJU MOHAN | S7 CSE

No matter whether payment of the public passenger transport ticket is made via a smartphone app or whether a prepaid card is used for the public swimming pool or a bonus card for the supermarket, many people already open their "electronic purses" every day. However, most of them are not aware of the fact that by doing so, they largely lose privacy. Researchers of Karlsruhe Institute of Technology (KIT) have developed a secure and anonymous system for daily use. It will be presented at the ACM CCS 2017 conference in the USA.

Computer scientist Andy Rupp, member of the "Cryptography and Security" working group of KIT, is always surprised about lacking problem awareness: "I observed that only few users are aware of the fact that by using such bonus or payment systems they disclose in detail how and what they consume or which routes they have taken." To prevent manipulation of the accounts by dishonest users, customer data and account balances of payment and bonus systems are usually administrated with the help of a central database. In every payment transaction, the customer is identified and the details of her/his transaction are transmitted to the central database. This repeated identification process produces a data trace that might be misused by the provider or third parties.

The cryptography expert did not want to resign himself to this apparent conflict of privacy and security. Together with Gunnar Hartung and Matthias Nagel of KIT and Max Hoffmann of Ruhr-Universität Bochum, he has now presented the basics of an "electronic purse" that works anonymously, but prevents misuse at the same time. The "black-box accumulation plus" (BBA+) protocol developed by them transfers all necessary account data to the card used or the smartphone and guarantees their confidentiality with the help of cryptographic methods. At the same time, BBA+ offers security guarantees for the operator of the bonus or payment system: The protocol guarantees a correct account balance and is mathematically constructed such that the identity of the user is disclosed as soon as the attempt is made to pay with a manipulated account.

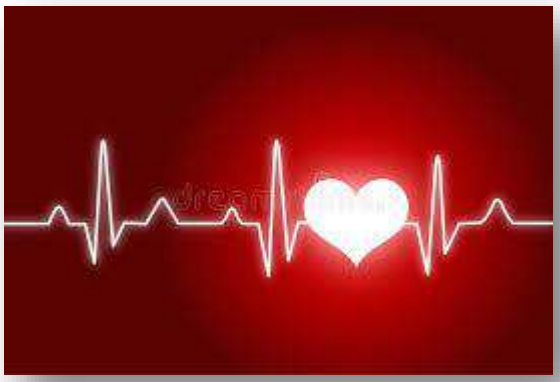
The new protocol is a further development of an anonymous bonus card system that was also designed by the KIT research group. For collecting and redeeming points, however, it required an internet connection to prevent misuse. "Our new protocol guarantees privacy and security for customers during offline operation as well," Andy Rupp says. "This is needed

for ensuring the payment system's suitability for daily use. Think of a subway turnstile or a toll bridge. There you may have no internet connection at all or it is very slow." Also its high efficiency makes the protocol suited for everyday use: During first test runs, researchers executed payments within about one second.

Reference: Karlsruher Institut für Technologie (KIT)

Heartbeat could be used as password to access electronic health records

P MALAVIKA SURESH | S7 CSE



Researchers at Binghamton University, State University of New York have devised a new way to protect personal electronic health records using a patient's own heartbeat.

"The cost and complexity of traditional encryption solutions prevent them being directly applied to telemedicine or mobile healthcare. Those systems are gradually replacing clinic-centered healthcare, and we wanted to find a unique solution to protect sensitive personal health data with something simple, available and cost-effective," said Zhanpeng Jin, assistant professor in the Department of Electrical and Computer Engineering at the Thomas J. Watson School of Engineering and Applied Science at Binghamton University. Jin is the co-author of a new paper titled "A Robust and Reusable ECG-based Authentication and Data Encryption Scheme for eHealth Systems."

Traditional security measures -- like cryptography or encryption -- can be expensive, time-consuming, and computing-intensive. Binghamton researchers encrypted patient data using a person's unique electrocardiograph (ECG) -- a measurement of the electrical activity of the heart measured by a biosensor attached to the skin -- as the key to lock and unlock the files.

"The ECG signal is one of the most important and common physiological parameters collected and analyzed to understand a patient's' health," said Jin. "While ECG signals are collected for clinical diagnosis and transmitted through networks to electronic health records, we strategically reused the ECG signals for the data encryption. Through this strategy, the security and privacy can be enhanced while minimum cost will be added."

Essentially, the patient's heartbeat is the password to access their electronic health records.

The identification scheme is a combination of previous work by Jin using a person's unique brainprint instead of traditional passwords for access to computers and buildings combined with cyber-security work from Guo and Chen.

"This research will be very helpful and significant for next-generation secure, personalized healthcare," said Jin.

Since an ECG may change due to age, illness or injury -- or a patient may just want to change how their records are accessed -- researchers are currently working out ways to incorporate those variables.

Assistant Professor Linke Guo and Associate Professor Yu Chen, along with PhD candidates Pei Huang and Borui Li, are co-authors of the paper.

Reference: Binghamton University

The force is strong: Amputee controls individual prosthetic fingers

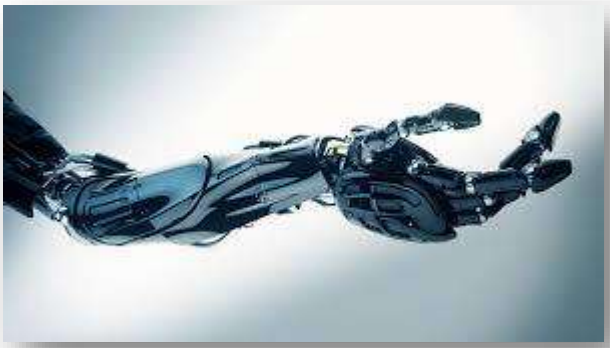
MEREENA BABY | S7 CSE

Luke Skywalker's bionic hand is a step closer to reality for amputees in this galaxy. Researchers at the Georgia Institute of Technology have created an ultrasonic sensor that allows amputees to control each of their prosthetic fingers individually. It provides fine motor hand gestures that aren't possible with current commercially available devices.

The first amputee to use it, a musician who lost part of his right arm five years ago, is now able to play the piano for the first time since his accident. He can even strum the Star Wars theme song.

"Our prosthetic arm is powered by ultrasound signals," said Gil Weinberg, the Georgia Tech College of Design professor who leads the project. "By using this new technology, the arm can detect which fingers an amputee wants to move, even if they don't have fingers."

Jason Barnes is the amputee working with Weinberg. The 28-year-old was electrocuted during a work accident in 2012, forcing doctors to amputate his right arm just below the elbow. Barnes no longer has his hand and most of his forearm but does have the muscles in his residual limb that control his fingers.



Barnes' everyday prosthesis is similar to the majority of devices on the market. It's controlled by electromyogram (EMG) sensors attached to his muscles. He switches the arm into various modes by pressing buttons on the arm. Each mode has two programmed moves, which are controlled by him either flexing or contracting his forearm muscles. For example, flexing allows his index finger and thumb to clamp together; contracting closes his fist.

"EMG sensors aren't very accurate," said Weinberg, director of Georgia Tech's Center for Music Technology. "They can detect a muscle movement, but the signal is too noisy to infer which finger the person wants to move. We tried to improve the pattern detection from EMG for Jason but couldn't get finger-by-finger control."

But then the team looked around the lab and saw an ultrasound machine. They partnered with two other Georgia Tech professors -- Minoru Shinohara (College of Sciences) and Levent Degertekin (Woodruff School of Mechanical Engineering) -- and attached an ultrasound probe to the arm. The same kind of probe doctors use to see babies in the womb could watch how Barnes' muscles moved.

"That's when we had a eureka moment," said Weinberg.

When Barnes tries to move his amputated ring finger, the muscle movements differ from those seen when he tries to move any other digit. Weinberg and the team fed each unique movement into an algorithm that can quickly determine which finger Barnes wants to move. The ultrasound signals and machine learning can detect continuous and simultaneous movements of each finger, as well as how much force he intends to use.

"It's completely mind-blowing," said Barnes. "This new arm allows me to do whatever grip I want, on the fly, without changing modes or pressing a button. I never thought we'd be able to do this."

This is the second device Weinberg's lab has built for Barnes. His first love is the drums, so the team fitted him with a prosthetic arm with two drumsticks in 2014. He controlled one of the sticks. The other moved on its own by listening to the music in the room and improvising.

The device gave him the chance to drum again. The robotic stick could play faster than any drummer in the world. Worldwide attention has sent Barnes and Weinberg's robots around the globe for concerts across four continents. They've also played at the Kennedy Center in Washington, D.C. and Moogfest.

That success pushed Weinberg to take the next step and create something that gives Barnes the dexterity he's lacked since 2012.

"If this type of arm can work on music, something as subtle and expressive as playing the piano, this technology can also be used for many other types of fine motor activities such as bathing, grooming and feeding," said Weinberg. "I also envision able-bodied persons being able to remotely control robotic arms and hands by simply moving their fingers."

Source: Georgia Institute of Technology

Virtual reality training may be as effective as regular therapy after stroke

RENJITH SAJI CHACKO | S7 CSE

Using virtual reality therapy to improve arm and hand movement after a stroke is equally as effective as regular therapy, according to a study published in the November 15, 2017, online issue of *Neurology*®, the medical journal of the American Academy of Neurology.

"Virtual reality training may be a motivating alternative for people to use as a supplement to their standard therapy after a stroke," said study author Iris Brunner, PhD, of Aarhus University, Hammel Neurocenter in Denmark. "Future studies could also look at whether people could use virtual reality therapy remotely from their homes, which could lessen the burden and cost of traveling to a medical center for standard therapy."

The study involved 120 people with an average age of 62 who had suffered a stroke on average about a month before the study started. All of the participants had mild to severe muscle weakness or impairment in their wrists, hands or upper arms. The participants had four to five hour-long training sessions per week for four weeks. The participants' arm and hand functioning was tested at the beginning of the study, after the training ended and again three months after the start of the study.

Half of the participants had standard physical and occupational therapy. The other half had virtual reality training that was designed for rehabilitation and could be adapted to the

person's abilities. The participants used a screen and gloves with sensors to play several games that incorporated arm, hand and finger movements.

"Both groups had substantial improvement in their functioning, but there was no difference between the two groups in the results," Brunner said. "These results suggest that either type of training could be used, depending on what the patient prefers."

Brunner noted that the virtual reality system was not an immersive experience. "We can only speculate whether using virtual reality goggles or other techniques to create a more immersive experience would increase the effect of the training," she said.

Reference: American Academy of Neurology (ANN)

First-ever autonomously controlled 'capsule robot' explores colon

JOEL JOHN | S7 CSE

New research shows that an 18-mm magnetized capsule colonoscope, which can be paired with standard medical instruments, successfully performed intricate maneuvers inside the colon while guided by an external magnet attached to a robotic arm. Researchers believe this technology will reduce the potential discomfort of colonoscopies and lead to more people undergoing the life-saving screening test. This new study was presented at Digestive Disease Week® (DDW) 2017 , the largest international gathering of physicians, researchers and academics in the fields of gastroenterology, hepatology, endoscopy and gastrointestinal surgery.

Researchers hope the capsule robot, which is inserted rectally, could be used safely and effectively in the future on humans to identify and remove pre-cancerous lesions and tumors detected during colonoscopy.

"There's no doubt in the value of colonoscopies to keep people healthy through preventive screening for colon cancer, but many individuals still avoid this procedure, because of fear of the test itself, perceived discomfort or the risk of sedation," said Keith Obstein, MD, MPH, FASGE, the study's corresponding author and associate professor of medicine at Vanderbilt

University Medical Center, Nashville, TN. "We developed this capsule robot to make traversing the GI tract much easier, for both the clinician and patient."

Dr. Obstein and his team tested the capsule robot, which has a tether that is smaller in diameter than conventional endoscopes, 30 times in the colon of a pig. They reported that it successfully completed the maneuver of retroflexion, in which it bends backward to give the endoscopist a "reverse-view" of the colon wall, on its own (i.e. autonomously/autopilot) at the press of a button.

"Not only is the capsule robot able to actively maneuver through the GI tract to perform diagnostics, it is also able to perform therapeutic maneuvers, such as biopsies of tissue or polyp removal, due to the tether -- something that other capsule devices are unable to do," added Dr. Obstein. "Since the external magnet pulls the capsule robot with the tether segment from the front or head of the capsule, instead of a physician pushing the colonoscope from behind as in traditional endoscopy, we're able to avoid much of the physical pressure that is placed on the patient's colon -- possibly reducing the need for sedation or pain medication."

The team found that the autonomously-controlled capsule robot was successful in completing all 30 retroflexions. The capsule robot completed retroflexion in an average of 12 seconds, which was within the researchers' expectations.

Following the success of these tests in a pig, Dr. Obstein indicated that the team will be pursuing human trials, expected to begin at the end of 2018. In the meantime, his team will continue to optimize the algorithms that control the robotic arm to improve their performance in maneuvering the capsule-based robotic system.

Reference: Digestive Disease Week

Technique to allow AI to learn words in the flow of dialogue developed

SIDDHARTH PRAJOSH C S7 CSE

A group of researchers at Osaka University has developed a new method for dialogue systems*1. This new method, lexical acquisition through implicit confirmation, is a method for a computer to acquire the category of an unknown word over multiple dialogues by confirming whether or not its predictions are correct in the flow of conversation.

Many conversation robots, chatbots, and voice assistant apps have appeared in recent years; however, in these systems, computers basically answer questions based on what has been preprogrammed. There is another method in which a computer learns from humans by asking simple repetitive questions; however, if the computer asks only questions such as "What is xyz?" in order to acquire knowledge, users will lose interest in talking with the computer.

The group led by Professor Komatani developed an implicit confirmation method by which the computer acquires the category of an unknown word during conversation with humans. This method aims for the system to predict the category of an unknown word from user input during conversation, to make implicit confirmation requests to the user, and to have the user respond to these requests. In this way, the system acquires knowledge about words during dialogues.

In this method, the system decides whether the prediction is correct or not by using the user response following each request, its context, by using machine learning*2 techniques. In addition, this system's decision performance improved by taking the classification results gained from dialogues with other users into consideration.

Chatbots in the market speak to anyone in the same manner. However, as dialogue systems become popular in the future, computers will be required to speak by learning from a conversational partner according to the situation. This group's research results are a new approach towards the realization of dialogue systems in which a computer can become smarter through conversation with humans and will lead to the development of dialogue systems with the ability to customize responses to the user's situation.

This research project was conducted as a part of joint research with Honda Research Institute Japan Co., Ltd.

Reference: Osaka University

Automatic code reuse: System automatically modifies code for transfer to other programs

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Researchers at MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) have developed a new system that allows programmers to transplant code from one program into another. The programmer can select the code from one program and an insertion point in a second program, and the system will automatically make modifications necessary -- such as changing variable names -- to integrate the code into its new context. Crucially, the system is able to translate between "data representations" used by the donor and recipient programs. An image-processing program, for instance, needs to be able to handle files in a range of formats, such as jpeg, tiff, or png. But internally, it will represent all such images using a single standardized scheme. Different programs, however, may use different internal schemes. The CSAIL researchers' system automatically maps the donor program's scheme onto that of the recipient, to import code seamlessly.

The researchers presented the new system, dubbed CodeCarbonCopy, at the Association for Computing Machinery's Symposium on the Foundations of Software Engineering.

"CodeCarbonCopy enables one of the holy grails of software engineering: automatic code reuse," says Stelios Sidiroglou-Douskos, a research scientist at CSAIL and first author on the paper. "It's another step toward automating the human away from the development cycle. Our view is that perhaps we have written most of the software that we'll ever need -- we now just need to reuse it."

The researchers conducted eight experiments in which they used CodeCarbonCopy to transplant code between six popular open-source image-processing programs. Seven of the eight transplants were successful, with the recipient program properly executing the new functionality.

Joining Sidiroglou-Douskos on the paper are Martin Rinard, a professor of electrical engineering and computer science; Fan Long, an MIT graduate student in electrical engineering and computer science; and Eric Lahtinen and Anthony Eden, who were contract programmers at MIT when the work was done.

With CodeCarbonCopy, the first step in transplanting code from one program to another is to feed both of them the same input file. The system then compares how the two programs process the file.

If, for instance, the donor program performs a series of operations on a particular piece of data and loads the result into a variable named "mem_clip->width," and the recipient performs the same operations on the same piece of data and loads the result into a variable named "picture.width," the system will infer that the variables are playing the same roles in their respective programs.

Once it has identified correspondences between variables, CodeCarbonCopy presents them to the user. It also presents all the variables in the donor for which it could not find matches in the recipient, together with those variables' initial definitions. Frequently, those variables are playing some role in the donor that's irrelevant to the recipient. The user can flag those variables as unnecessary, and CodeCarbonCopy will automatically excise any operations that make use of them from the transplanted code.

To map the data representations from one program onto those of the other, CodeCarbonCopy looks at the precise values that both programs store in memory. Every pixel in a digital image, for instance, is governed by three color values: red, green, and blue. Some programs, however, store those triplets of values in the order red, green, blue, and others store them in the order blue, green, red.

If CodeCarbonCopy finds a systematic relationship between the values stored by one program and those stored by the other, it generates a set of operations for translating between representations.

CodeCarbonCopy works well with file formats, such as images, whose data is rigidly organized, and with programs, such as image processors, that store data representations in arrays, which are essentially rows of identically sized memory units. In ongoing work, the researchers are looking to generalize their approach to file formats that permit more flexible data organization and programs that use data structures other than arrays, such as trees or linked lists.

Reference: Massachusetts Institute of Technology