DHANEKULA INSTITUTE OF ENGINEERING & TECHNOLOGY: GANGURU

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Bi-Monthly Newsletter

TELE-ELECTRO

Vol No:5 Issue No:6 April-May 2019

Beyond 1 and 0: Engineers boost potential for creating successor to shrinking transistors

Computers and similar electronic devices have gotten faster and smaller over the decades as computer-chip makers have learned how to shrink individual transistors, the tiny electrical switches that convey digital information. Scientists' pursuit of the smallest possible transistor has allowed more of them to be packed onto each chip. But that race to the bottom is almost over: Researchers are fast approaching the physical minimum for transistor size, with recent models down to about 10 nanometers or just 30 atoms wide. "The processing power of electronic devices comes from the hundreds of millions, or billions, of transistors that are interconnected on a single computer chip," said Dr. Kyeongjae Cho, professor of materials science and engineering at The University of Texas at Dallas.

To extend the quest for faster processing speed, the microelectronics industry is looking for alternative technologies. Cho's research, published online April 30 in the journal *Nature Communications*, might offer a solution by expanding the vocabulary of the transistor. Conventional transistors can convey just two values of information: As a switch, a transistor is either on or off, which translates into the 1s and 0s of binary language. One way to increase processing capacity without adding more transistors would be to increase how much information each transistor conveys by introducing intermediate states between the on and off states of binary devices. A so-called multi-value logic transistor based on this principle would allow more operations and a larger amount of information to be processed in a single device. The concept of multi-value logic transistors is not new, and there have been many attempts to make such devices.

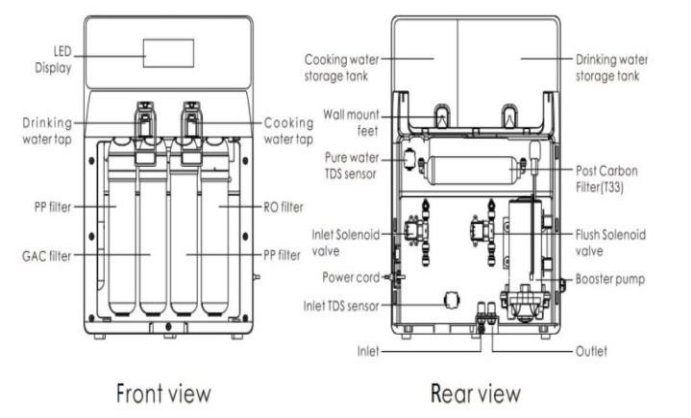
Through theory, design and simulations, Cho's group at UT Dallas developed the fundamental physics of a multi-value logic transistor based on zinc oxide. Their collaborators in South Korea successfully fabricated and evaluated the performance of a prototype device. Cho's device is capable of two electronically stable and reliable intermediate states between 0 and 1, boosting the number of logic values per transistor from two to three or four. Cho said the new research is significant not only because the technology is compatible with existing computer-chip configurations, but also because it could bridge a gap between today's computers and quantum computers, the potential next landmark in computing power. While a conventional computer uses the precise values of 1s and 0s to make calculations, the fundamental logic units of a quantum computer are more fluid, with values that can exist as a combination of 1s and 0s at the same time or anywhere in between. Although they have yet to be realized commercially, large-scale quantum computers are theorized to be able to store more information and solve certain problems much faster than current computers. A device incorporating multi-level logic would be faster than a conventional computer because it would operate with more than just binary logic units. With quantum units, you have continuous values. "The transistor is a very mature technology, and quantum computers are nowhere close to being commercialized," he continued. "There is a huge gap. So how do we move from one to the other? We need some kind of evolutionary pathway, a bridging technology between binary and infinite degrees of freedom.

The technology Cho and his colleagues developed uses a novel configuration of two forms of zinc oxide combined to form a composite nanolayer, which is then incorporated with layers of other materials in a superlattice.The researchers discovered they could achieve the physics needed for multi-value logic by embedding zinc oxide crystals, called quantum dots, into amorphous zinc oxide. The atoms comprising an amorphous solid are not as rigidly ordered as they are in crystalline solids. "By engineering this material, we found that we could create a new electronic structure that enabled this multi-level logic behavior," said Cho, who has applied for a patent. "Zinc oxide is a well-known material that tends to

form both crystalline solids and amorphous solids, so it was an obvious choice to start with, but it may not be the best material. Our next step will look at how universal this behavior is among other materials as we try to optimize the technology.

Mr.S.Chandrasekhar
Assistant Professor , ECE

OCEO: A Smart Water Purifier at Zero Purchase Cost



Quality of drinking water is one thing that we cannot afford to compromise – not one bit. Water-borne diseases like diarrhoea, hepatitis, typhoid and cholera, or illness due to contaminants like arsenic or lead cause large-scale health hazards in India. Reports suggest that over 10,000 lives fell victim to these diseases from 2013 to 2017 in the country. To monitor water quality and reduce contamination, smart sensor-based technologies and filters are used, which often lead to high capital costs for consumers. To address this challenge, Bengaluru-based startup OCEO Water, founded by Mahendra Dantewadiya, Rajeev Krishna, Vikram Gulecha and Hasmukh Gulecha, has designed a technology that detects, purifies, measures and monitors drinking water, for zero upfront or maintenance cost and just Re.1 per litre of water consumed by the user!

The inception

The OCEO team came up with an IoT-enabled water purification-as-a-service solution looking at the heavy upfront and operational costs, maintenance hassles and the needs for improvement of existing water purifier solutions in the market.

Vikram Gulecha says, “Access to safe drinking water is a basic human right – not a privilege. Expenses for existing solutions, however, are very high. Moreover, water quality in India varies every 200 km. Some regions may have higher arsenic content in water, some may have chloride, some may contain iron, and so on. The aim of OCEO is to be able to purify water as per the specific problem existing in an area, as each contaminant requires a different approach for purification”.

How it works

OCEO is an IoT-enabled Smart Water Purifier installed at the user’s location. The backbone of the technology lies in the blend of digital tools, internet-linked sensors, online analytics and report display on the devices. Water coming in from any source (tap, pump, tanker etc.) is first purified in the filter through six broad steps of filtration, carried out by a variety of elements. The six steps include polypropylene filtration, activated carbon filtration, Ultrafiltration (UF), reverse osmosis filtration, filtration through silver impregnated carbon filter and finally, water mineralisation.

“When water is being dispensed, a sensor reads the quality of each drop of water and sends the data to live cloud storage in real-time”, informs Krishna. OCEO communicates to the network through GSM, meaning a SIM card is fitted in the purifier. The data can be accessed as insightful analytics using OCEO’s mobile and web application. In addition, device health can also be verified using analytics. This facilitates predictive maintenance of the device, allowing auto-order of cartridges or filter membranes beforehand. The firm claims the setup is simple

enough for users to change filters and perform operations by themselves (Quick & Easy DIY).

Users can consume any amount of water needed. Keeping in mind an Indian household consumption, OCEO machine are designed optimum to dispense 15 litres of water every hour. OCEO has kept their technology open and is inviting solution developers to join hands in developing new solutions for the increasing water challenges across the globe.

Target audience and purchase model

OCEO's main target audiences are the end consumers from cities as well as semi-urban and rural areas. The most interesting aspect of their offering is the total zero cost deployment model. This means customers do not have to pay anything for the device, installation or even maintenance (including filter membrane replacement). Instead, users have to pay as per consumption, at the rate of Re. 1 per litre. The service has to be availed on a prepaid basis. Users can purchase 'water credits' using the application from OCEO mobile application or website – for instance, they can purchase 200 water credits to consumer 200 litres of water. The unqiue predictive maintenance auto-order fresh replacement membranes based on the incoming water quality and consumption from the device

Challenges during the venture

The main challenge for team OCEO came while trying to understand the needs of the customer and having the ultimate solution for the job that needed to be done. Vikram Gulecha recalls, "It involved figuring out the right solution for customers, the right channels to reach them and the right customer relationships to have. It also entailed figuring out the right price points and cost structures for profitability."

The design method also had to be modified, keeping in mind the usage habits of the customers. "Changing behavior is hard. Traditional design methods are not always enough to effectively tackle complex behavioral challenges at the customer's end. Our team took a unique behavioral approach towards product design, with a lot focus on primary market research", Vikram adds.

Revenue strategy

When asked whether the revenue stream is a challenge, given that the company is baring most of the costs, Dantewadiya answered, "this is more like the business model that airlines use. They lease aircrafts and finance all the services and maintenance. Passengers just pay for their trip. In OCEO too, we are the financier of all the services while consumers can pay only for their consumption".

He believes low-cost water purification options in the market should have been there a long time back. He adds, "The pay-as-you-use model will make drinking water more affordable, and can save consumers up to 80 percent of the expenses per month. It will draw more consumers. So, we are looking into additional revenue streams for the longer run."

They keep their overall cost low by maintaining a direct manufacturer-to-consumer channel, avoiding middlemen. "There would be at least 8-10 levels of middlemen if we planned to take the traditional of distribution. We completely omit this step. Moreover, we do not endorse our product through high-budget TV advertorials! Our customers are our own endorsers. That saves a lot of expense", expresses Hasmukh Gulecha.

Roadmap ahead

Gulecha and his team have a few plans with regards to the OCEO device as well as its distribution and production. They have started off with Bengaluru and are in the process of commercial distribution in Chennai and Hyderabad. They will have technical teams in each of these regions for customer service and support. They plan to expand throughout the nation slowly.

Currently, they are manufacturing their products from China, Taiwan and Korea. However, they have received proposals from multiple state governments to help in setting up their own manufacturing facility within the country. They plan to set up two facilities – one in the northern India and another in the south.

The team is customising OCEO to fit the requirements of big offices too, which includes

increasing the water capacity, as offices require much higher water daily. This will open up more target customer groups for them. Dantewadiya says that overall, OCEO plans to expand and cater the consumers in India first, and once they meet the demands here, they plan to expand globally.

Dr.G.L.Madhumati
Professor & HOD, ECE.

Heart of next-generation chip-scale atomic clock

Physicists at the National Institute of Standards and Technology (NIST) and partners have demonstrated an experimental, next-generation atomic clock ticking at high "optical" frequencies that is much smaller than usual, made of just three small chips plus supporting electronics and optics. Described in *Optica*, the chip-scale clock is based on the vibrations, or "ticks," of rubidium atoms confined in a tiny glass container, called a vapor cell, on a chip. Two frequency combs on chips act like gears to link the atoms' high-frequency optical ticks to a lower, widely used microwave frequency that can be used in applications. The chip-based heart of the new clock requires very little power (just 275 milliwatts) and, with additional technology advances, could potentially be made small enough to be handheld. Chip-scale optical clocks like this could eventually replace traditional oscillators in applications such as navigation systems and telecommunications networks and serve as backup clocks on satellites.

"We made an optical atomic clock in which all key components are microfabricated and work together to produce an exceptionally stable output," NIST Fellow John Kitching said. "Ultimately, we expect this work to lead to small, low-power clocks that are exceptionally stable and will bring a new generation of accurate timing to portable, battery-operated devices." The clock was built at NIST with help from the California Institute of Technology (Pasadena, Calif.), Stanford University (Stanford, Calif.) and Charles Stark Draper Laboratories (Cambridge, Mass.). Standard atomic clocks operate at microwave frequencies, based on the natural vibrations of the cesium atom -- the world's primary definition of the second. Optical atomic clocks, running at higher frequencies, offer greater precision because they divide time into smaller units and have a high "quality factor," which reflects how long the atoms can tick on their own, without outside help. Optical clocks are expected to be the basis for a future redefinition of the second.

In NIST's original chip-scale atomic clock, the atoms were probed with a microwave frequency. Commercial versions of this clock have become an industry standard for portable applications requiring high timing stability. But they require initial calibration and their frequency can drift over time, resulting in significant timing errors. Compact optical clocks are a possible step up. Until now, optical clocks have been bulky and complex, operated only as experiments by metrological institutions and universities. Optical ticks in rubidium have been studied extensively for use as frequency standards and are accurate enough to be used as length standards. NIST's rubidium vapor cell and the two frequency combs are microfabricated in the same way as computer chips. This means they could support further integration of electronics and optics and could be mass produced -- a path toward commercially viable, compact optical clocks. NIST's chip-based optical clock has an instability of 1.7 x 10?13 at 4,000 seconds -- about 100 times better than the chip-scale microwave clock. The clock works like this: The rubidium atoms' tick at an optical frequency in the terahertz (THz) band. This ticking is used to stabilize an infrared laser, called a clock laser, which is converted to a gigahertz (GHz) microwave clock signal by two frequency combs acting like gears. One comb, operating at a THz frequency, spans a broad enough range to stabilize itself. The THz comb is synchronized with a GHz frequency comb, which is used as a finely spaced ruler locked to the clock laser. The clock thus produces a GHz microwave electrical signal -- which can be measured by conventional electronics that is stabilized to the rubidium's THz vibrations.

P,Nandini Devi, Roll No:168T1A0481,III ECE-B

New way to beat the heat in electronics

Flexible insulator offers high strength and superior thermal conduction

A nanocomposite invented at Rice University's Brown School of Engineering promises to be a

superior high-temperature dielectric material for flexible electronics, energy storage and electric devices.

The nanocomposite combines one-dimensional polymer nanofibers and two-dimensional boron nitride nanosheets. The nanofibers reinforce the self-assembling material while the "white graphene" nanosheets provide a thermally conductive network that allows it to withstand the heat that breaks down common dielectrics, the polarized insulators in batteries and other devices that separate positive and negative electrodes.The discovery by the lab of Rice materials scientist Pulickel Ajayan is detailed in *Advanced Functional Materials*.

Dielectrics must be thin, tough, flexible and able to withstand harsh environments. "Ceramic is a very good dielectric, but it is mechanically brittle," Rahman said of the common material. "On the other hand, polymer is a good dielectric with good mechanical properties, but its thermal tolerance is very low." Boron nitride is an electrical insulator, but happily disperses heat, he said. "When we combined the polymer nanofiber with boron nitride, we got a material that's mechanically exceptional, and thermally and chemically very stable," Rahman said.

The 12-to-15-micron-thick material acts as an effective heat sink up to 250 degrees Celsius (482 degrees Fahrenheit), according to the researchers. Tests showed the polymer nanofibers-boron nitride combination dispersed heat four times better than the polymer alone. In its simplest form, a single layer of polyaramid nanofibers binds via van der Waals forces to a sprinkling of boron nitride flakes, 10% by weight of the final product. The flakes are just dense enough to form a heat-dissipating network that still allows the composite to retain its flexibility, and even foldability, while maintaining its robustness. Layering polyaramid and boron nitride can make the material thicker while still retaining flexibility, according to the researchers. "The 1D polyaramid nanofiber has many interesting properties except thermal conductivity," Rahman said. "And boron nitride is a very interesting 2D material right now. They both have different independent properties, but when they are together, they make something very unique."

M.Jyothsna Sai Lakshmi, 168T1A0475, III ECE-B

List of Faculty participated in FDP's /Workshops/Seminars/Short term Programs

S. No	Name of the Faculty/ Staff	Date	Institution	Topic
1	Mr V Subba Raju	26-5-2018 to 31-5-2018	NIT Warangal	IOT and its use perspective
2	Mr S Chandra Sekhar	22-10-2018 to 26-10-2018	IIT Bombay	Nano Fabrication Technologies
3	Mr A Sivannaraya na	21-11-2018 to 26-11-2016	NIT Warangal	Information Theory-Coding Applications
4	Ms K Radha	17-11-2018	VRSEC	VLSI Design and Challenges
5.	Mr A Sivannaraya na	15-3-2019	DIET Ganguru	Moodle Learning Management System, IIT Bombay
6.	P.Krishna Reddy	15-3-2019	DIET Ganguru	Moodle Learning Management System, IIT Bombay
7.	V.Subba Raju	15-3-2019	DIET Ganguru	Moodle Learning Management System, IIT Bombay
8.	Dr.P.Pavithra Roy	15-3-2019	DIET Ganguru	Moodle Learning Management System, IIT Bombay
9.	Dr.G.L.Madhumathi	15-3-2019	DIET Ganguru	Moodle Learning Management System, IIT Bombay

List of Faculty Publications: Journals

S.No.	Title of paper	Name of the author/s	Name of Journal	Year of publication/ ISBN/ISSN number
1	10T SRAM - V_{DD} pre-charge using read port for low Switching power and low RBL leakage	Mr S Chandra Sekhar	International Journal of Research	2018 e-ISSN: 2348-6848, P-ISSN:2348-795X
2.	Carry skip adder -high speed operating under wide range of supply logic at different levels	Mr S Chandra Sekhar	International Journal of Scientific Development and Research	2018 ISSN:2455-2631
3.	Satellite Image Resolution Enhancement based on Dual Domain Filtering	Mr M Tulasidas	International Journal of Engineering and Technology	2018 ISBN:7(2.7)(2018) 466-469
4.	An Efficient Tree structure 32-bit Brent-Kung Adder for Reducing Time Delay and Memory Utilization	Mrs.Y. Naga Prasanthi	Journal of Semiconductor Devices and Circuits	2018 2455-3379

List of Faculty Publications: Conferences

S.No.	Title of paper	Name of the author/s	Name of Journal	Year of publication/ ISBN/ISSN number
1.	A Novel feature of increased safety during car crashes	Mr S Chandra Sekhar	Second International Conference on Inventive Systems and Control	2018 978-1-5386-0806-7

PLACEMENTS IN ECE DEPARTMENT

List of Selected students in Department of Electronics & Communication Engineering

A.Name of Company: NTT DATA
Date of Drive: 11.05.2019
Package: 3 LPA
Number of candidates selected: 8

S.No	Roll Number	Name of the Student
1	158T1A0413	BATCHU BHARAT
2	158T1A0411	K.Bhanu Tejasri
3	158T1A0456	K Monika
4	158T1A0447	P Manasa
5	158T1A0493	N.Sravya
6	158T1A0462	K.NamrathA
7	158T1A0460	T.Chandrika
8	158T1A0444	L.Kaivalya

"Dream is not that which you see while sleeping, it is something that doesn't let you sleep"

Dr.APJ Abdul Kalam

Editorial and Design team:

Faculty: Mr.S.ChandraSekhar

Student Coordinators:

S.Rohith. B.Teena. K.Namratha S.Lohitha